ADAMAS UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

B. Tech (Bio-Medical Engineering)

Course Structure

Academic Year 2026 - 27

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING AND TECHNOLOGY
B. Tech (Bio-Medical Engineering)
Course Structure

FIRST YEAR

SEMESTER I								
S. No	**Type**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Contact Hrs/wk**	**Credits**
1	Theory (BSC)	MTH11501	Engineering Mathematics-I	3	1	0	4	4
2	Theory (BSC)	PHY11201	Applied Science	2	0	0	2	2
3	Theory (ESC)	MEE11002	Engineering Mechanics	2	1	0	3	3
		GEE11001	Electrical and Electronics Technology	2	1	0	3	3
4	Theory (HSSM)	ENG11053	English Communication	1	0	2	3	2
	Theory	GEE11012	Disruptive Technology Innovations	1	0	2	3	
5	Theory (BSC)	BIT11003	Life Sciences	2	0	0	2	2
6	Theory (Mandatory)	DGS11001	Design Thinking	1	0	2	3	2
	Theory (ESC)	CSE11001	Introduction to Programming	2	0	0	2	2
7	Practical (BSC)	PHY12202	Applied Science Lab	0	0	4	4	2
8	Practical (ESC)	CSE12002	Programming Lab	0	0	4	4	2
		GEE12002	Electrical and Electronics Technology Lab	0	0	2	2	1
9	Practical (ESC)	CEE12001	Engineering Drawing and CAD	0	0	4	4	2
		MEE12001	Engineering Workshop	0	0	4	4	
Total				11/12	2	16/18		

SEMESTER II								
S. No	**Type**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Contact Hrs/wk**	**Credits**
1.	Theory (BSC)	MTH11502	Engineering Mathematics– II	3	1	0	4	4
2.	Theory (ESC)	MEE11002	Engineering Mechanics	2	1	0	3	3
	Theory (ESC)	GEE11001	Electrical and Electronics Technology	2	1	0	3	3
3.	Theory (BSC)	EVS11107	Environmental Studies	2	0	2	4	3
4.	Theory (Mandatory)	DGS11001	Design Thinking	1	0	2	3	2
	Theory (ESC)	CSE11001	Introduction to Programming	2	0	0	2	2
5.	Theory	GEE11012	Disruptive Technology Innovations	1	0	2	3	2
	Theory (HSSM)	ENG11053	English Communication	1	0	2	3	
6.	Theory (Mandatory)	EIC11001	Venture Ideation	2	0	0	2	2
7		CLL	TBD	0	0	2	2	1
8.	Practical (ESC)	GEE12002	Electrical and Electronics Technology Lab	0	0	2	2	1
		CSE12002	Programming Lab	0	0	4	4	2
9	Practical (ESC)	MEE12001	Engineering Workshop	0	0	4	4	2
		CEE12001	Engineering Drawing and CAD	0	0	4	4	
			Total	11/12	2	12	25/23	

SEMESTER III								
S. No	**Type**	**Course Code**	**Subject Name**	**L**	**T**	**P**	**Contact Hrs/wk**	**Credits**
1	Theory (BSC)	MTH11526	Engineering Mathematics – III (Transform Calculus & Special functions)	**3**	**1**	**0**	**3**	**4**
2	Theory (PCC)	**BME11001**	**PC- I (Analog and Digital Electronics)**	**3**	**1**	**0**	**3**	**4**
3	Theory (PCC)	**BME11002**	**PC- II (Anatomy and Physiology)**	**3**	**0**	**0**	**3**	**3**
4	Theory (PCC	**BME11003**	Prof. Core – III (Signals and Network Analysis)	**3**	**1**	**0**	**4**	**4**
5	Theory (PCC	**BME11004**	**PC- IV Biomedical sensors and Transducers**	**3**	**0**	**0**	**3**	**3**
6	Practical (PCC)	**BME12005**	**PC-III Lab (Signals and Network Analysis Lab)**	**0**	**0**	**2**	**2**	**1**
7	Practical (PCC)	**BME12006**	**PC-I Lab (Analog and Digital Electronics Lab)**	**0**	**0**	**2**	**2**	**1**
8	Practical (PCC)	**BME12007**	**PC-II Lab Basic Anatomy and Physiology Lab**	**0**	**0**	**2**	**2**	**1**
9	Practical (Mandatory)	**IDP14001**	**Interdisciplinary Project**	**0**	**0**	**0**	**6**	**3**
10	Practical	**SOC14100**	**Community Service**	**0**	**0**	**0**	**0**	**1**

	(Mandatory)							
11		CLL	TBD	0	0	2	2	1
Total				**15**	**3**	**6**	**26**	**26**

SEMESTER IV

S. No	Type	Course Code	Subject Name	L	T	P	Contact Hrs/wk	Credits
1	Theory (PCC)	**BME11008**	**PC- V (Basic Clinical Science)**	**3**	**0**	**0**	**3**	**3**
2	Theory (PCC)	**BME11009**	**PC- VI (Biomedical Signal acquisition and processing)**	**3**	**1**	**0**	**3**	**4**
3	Theory (PCC)	**BME11010**	**PC- VII (Microcontroller and Interfacing)**	**3**	**1**	**0**	**4**	**4**
4	Theory (PCC	**BME11011**	**PC- VIII (Biomaterials)**	**3**	**0**	**0**	**3**	**3**
5	Theory (PCC	**BME11012**	**PC- IX Medical Imaging**	**3**	**0**	**0**	**3**	**3**
6	Practical (PCC)	**PSG11021**	**Human Values and Professional Ethics**	**2**	**0**	**0**	**2**	**2**
7	Practical (PCC)	**BME12013**	**PC- VI Lab (Biomedical Signal Processing Lab)**	**0**	**0**	**2**	**2**	**1**
8	Practical (PCC)	**BME12014**	**PC- VII Lab (Microcontroller and Interfacing Lab)**	**0**	**0**	**2**	**2**	**1**
9	Practical	**BME12015**	**PC-V Basic Clinical**	**0**	**0**	**2**	**2**	**1**

	(PCC)		**Science Lab**					
10		CLL	TBD	0	0	2	2	1
Total				**17**	**2**	**6**	**26**	**23**

SEMESTER V								
S. No	Type	Course Code	Subject Name	L	T	P	Contact Hrs/wk	Credits
1	Theory (PCC)	BME11016	PC- XI (Biomechanics)	3	1	0	4	4
2	Theory (PCC)	BME11017	PC- XII Troubleshooting and Quality Control of Medical Devices	3	0	0	3	3
3	Theory (PCC)	BME11018	PC- X (Biomedical Instrumentation – I)	3	0	0	3	3
4	Theory (PEC)	BME11019 BME11020 ECE11017	PE- I 1. Modelling and Simulations of Biomedical Systems 2. Digital System Design 3. Foundation on Artificial Intelligence and Machine Learning	3	0	0	3	3
5	Theory (PEC)	BME11021 BME11022 BME11023	PE – II 1.Bio-fluid mechanics 2.Bioinformatics 3.Hospital management system	3	0	0	3	3
6	Practical (PCC)	BME12024	PC- X Lab (Biomedical Instrumentation – I Lab)	0	0	2	2	1
7	Practical (PCC)	BME12025	PC- IX Lab (Biomechanics Lab)	0	0	2	2	1
8	Practical (PEC)	BME12026 BME12027	PE-I Lab Digital System Design Lab Modelling and Simulations of	0	0	2	2	1

		ECE12046	Biomedical Systems Lab Artificial Intelligence and Machine Learning Lab					
9	Seminar (P/S/I)	BME15033	TECHNICAL SEMINAR	0	0	2	2	1
10		CLL	TBD	0	0	2	2	1
Total				15	2	8	25	21

SEMESTER VI								
S. No	**Type**	**Course Code**	**Subject Name**	**L**	**T**	**P**	**Contact Hrs/wk**	**Credits**
1	Theory (PCC)	**BME12028**	**PC- XII (Biological Control Systems)**	**3**	**1**	**0**	**4**	**4**
2	Theory (PCC)	**BME11029**	**PC- XIII (Digital Image Processing)**	**3**	**1**	**0**	**4**	**4**
3	Theory (HSSM)	**ECO11505**	**Economics for Engineers**	**3**	**0**	**0**	**3**	**3**
4	Theory (PEC)	**BME11030** **BME11031** **BME11032**	**Prof. Elective – III** **1. Internet of Medical Things (IoMT)** **2.Drug delivery system** **3. Laser and fiber optics in medicine**	**3**	**0**	**0**	**3**	**3**
5	Theory (PEC)	**BME11033** **BME11034** **BME11035**	**Prof. Elective – IV** **1. Rehabcare Engineering** **2. Biofabrication** **3. BioMEMs and Biomicrofluidics**	**3**	**0**	**0**	**3**	**3**
6	Theory (OEC)	**ECE11034** **CEE11029** **BME11036**	**Open Elective- I** **Internet of Things** **Disaster Management** **Radiotherapy and**	**3**	**0**	**0**	**3**	**3**

			Nuclear Medicine					
7	Practical (PCC)	**BME12037**	**PC- XII Lab (Biological Control Systems Lab)**	**0**	**0**	**2**	**2**	**1**
8	Practical (PCC)	BME12038	**PC- XIII Lab (Digital Image Processing Lab)**	**0**	**0**	**2**	**2**	**1**
9	Practical (PEC)	BME12039 BME12040 BME12041	**Prof. Elective – Lab** **1. Internet of Medical Things Lab** **2. Drug delivery system Lab** **3. Laser and fiber optics in medicine Lab**	**0**	**0**	**2**	**2**	**1**
10		CLL	TBD	0	0	2	2	1
Total				**18**	**2**	**6**	**26**	**24**

SEMESTER VII								
S. No	**Type**	**Course Code**	**Subject Name**	**L**	**T**	**P**	**Contact Hrs/wk**	**Credits**
1	Theory (HSSM)	MGT11402	Industrial Management	3	0	0	3	3
2	Theory (PCC)	BME11042	PC – XIV (Biomedical Instrumentation-II)	3	1	0	4	4
3	Theory (PEC)	 BME11043 BME11044 BME11045	Prof. Elective- V 1. Telemedicine 2. Tissue Engineering & Design of Implants 3. Artificial Intelligence and Machine Learning Applications in Biomedical Engineering	3	0	0	3	3
4	Theory (OEC)	 BME11047 BME11049	Open Elective – II Biomedical Device Design Biomedical Nano Technology	3	0	0	3	3

5	Theory (OEC)	ECE11037 ECE11038	Open Elective – III Mobile Communication Optical fiber Communication	3	0	0	3	3
6	Practical (PCC)	BME12050	PC Lab – XIV (Biomedical Instrumentation-II Lab)	0	0	2	2	1
7	Practical (PEC)	BME12051 BME12052 BME12053	Prof. Elective Lab 1. Telemedicine Lab 2. Tissue Engineering and Design of Implants Lab 3. Artificial Intelligence and Machine Learning Applications in Biomedical Engineering Lab	0	0	2	2	1
8	Practical (PCC)	BME14035	Summer Internship	0	0	0	2	2
9	Practical (PCC)	BME14036	Minor Project	0	0	6	6	3
10		CLL	TBD	0	0	2	2	1
Total				15	1	10	28	24

SEMESTER VIII								
S. No	**Type**	**Course Code**	**Subject Name**	**L**	**T**	**P**	**Contact Hrs/wk**	**Credits**
1	Practical (PCC)	BME14037	Industry Work Experience / SIRE* / Major Project	0	0	12	12	6
2	Practical (PCC)	BME14038	Comprehensive Viva Voce	0	0	0	0	2
Total				0	0	12	12	8

***SIRE: Scientific Investigation & Research Experience**

Total Credits (4th Year) = 31 Credits

Total Credits Distribution Semester wise: (B. Tech)

Semester	I	II	III	IV	V	VI	VII	VIII	Total Credits
Credits	20	21	26	23	21	24	24	08	167

MTH11501	Engineering Mathematics-I	L	T	P	C
Version 1.0	Contact Hours – 45	3	1	0	4
Pre-requisites/Exposure	12th level Mathematics				
Co-requisites	--				

Course Objectives

1. To help the student to understand basic concept of abstract and vector algebra with its uses in engineering science.
2. To give emphasis about concepts of differential calculus and enable students to apply these topics in real life problems.
3. To give the students a perspective to learn integral calculus and its importance in advanced study in engineering science.
4. To enable students, acquire fundamental concept of ordinary differential equation and its applications in engineering science.

Course Outcomes

On completion of this course, the students will be able to

On completion of this course, the students will be able to

CO1: Define fundamental concepts related to Calculus, Linear Algebra, and Vector Algebra

CO2: Explain the mathematical principles and theorems associated with Calculus and linear algebra

CO3: Apply various techniques from calculus, vector, and linear algebra to solve problems

CO4: Analyze and interpret mathematical results from the domain of study

CO5: Critically evaluate advanced mathematical problems and theorems
CO6: Create mathematical models for complex real-world problem

Catalog Description
For engineering course, Mathematics is the backbone. Students will be having good engineering skills if their idea for Mathematics is clear. In this course the focus will be to learn Mathematics in depth which will motivate students to grow their thinking ability for Engineering also. By knowing the theory student will be able to apply that successfully to all kind of problems of Engineering and science. Class participation is a fundamental aspect of this course. Students will be encouraged to actively take part in all group activities (Problem solving, presentation etc.).

Course Content

Unit I: Differential Calculus [20L]
Introduction to limit, continuity, derivative for function of one variable; Successive differentiation, Leibnitz's theorem; Rolle's theorem, Lagrange's mean value theorem, Taylor's and Maclaurin's theorems with remainders; Indeterminate forms; Concavity and convexity of a curve, Points of inflexion, Maxima and Minima
Limit, continuity, and differentiability of a functions of several variables; partial derivatives and their geometrical interpretation; chain rule, total derivative, derivatives of composite and implicit functions; homogeneous function, Euler's theorem on homogeneous functions; Jacobian of variable transformation; maxima and minima of functions of several variables, Lagrange's method of multipliers

Unit II: Integral Calculus [15L]
Review of definite integrals, Reduction formulae, Improper integral, Beta and Gamma functions, elementary properties, Rectification, double and triple integrals, computations of area, surfaces and volumes, change of variables in double integrals, applications

Unit III: Linear Algebra [18L]
Basics of real and complex matrices, Determinant and its properties, Orthogonal matrices, Hermitian and skew-Hermitian matrices, Unitary matrices, Elementary row and column operations on a matrix, Rank, echelon form, Inverse of a matrix using elementary operations, Solution of system of linear equations, Consistency, Characteristic equation, Caley-Hamillton theorem, eigenvalues and eigenvectors, algebraic and geometric multiplicity, diagonalization

Unit IV: Vector Algebra [7L]
Scalar and vector fields, Vector product, Scalar triple product and their interpretation, directional derivative, gradient, Curl, divergence
Text Book:

1. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill

2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House

Reference Book:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications
2. G. B. Thomas Jr., M. D. Weir, J. R. Hass, Thomas Calculus Early Transcendentals, 12th Edition
3. James Stewart, Calculus: Concepts and Contexts, 4th Edition, Cengage Learning

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Name:		Engineering Mathematics-I						Course Code:		MTH11501					
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0
CO2	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0
CO3	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0
CO4	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0
CO5	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0
CO6	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0
Average	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0

1=weakly mapped
2= moderately mapped
3=strongly mapped

Model Question Paper

ADAMAS UNIVERSITY PURSUE EXCELLENCE	**ADAMAS UNIVERSITY** **END SEMESTER EXAMINATION** (Academic Session: 20-- – 20--)		
Name of the Program:	B.Tech	**Semester:**	I
Paper Title:	Engineering mathematics I	**Paper Code:**	MTH11501
Maximum Marks:	50	**Time Duration:**	3 Hrs
Total No. of Questions:	17	**Total No of Pages:**	

1. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
2. All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

	Group A **Answer All the Questions (5 x 1 = 5)**		
1	What is the value of y_n if $y = e^{5x}$	**U**	**CO1**
2	Demonstrate Beta function.	**Ap**	**CO2**
3	Define basis of a vector space.	**Ap**	**CO3**
4	What is Cayley-Hamilton theorem?	**Ap**	**CO3**
5	If $\vec{c}$ is a constant vector and $\vec{r} = x\hat{\imath} + y\hat{\jmath} + z\hat{k}$, then what is the value of $grad\ (\vec{c}.\vec{r})$?	**R**	**CO4**
	Group B **Answer All the Questions (5 x 2 = 10)**		
6 a)	Find the Jacobian $J\left(\frac{u,v}{x,y}\right)$ if $u = x - y, v = x^2 - y^2$	**U**	**CO1**
	(OR)		
6 b)	Find the value of $\lim_{x\to 0} \frac{e^x - x - 1}{x^2}$ using L'Hospital rule.	**U**	**CO1**
7 a)	Define the reduction formula of $\int sin^n x\, dx$	**Ap**	**CO2**
	(OR)		
7 b)	Find the value of $\int_0^{\pi/4} tan^n x\, dx$	**Ap**	**CO2**
8 a)	What is the value of a for which the following system of equations has unique solution? $x + y + z = 1$ $x + 2y - z = 2$ $5x + 7y + az = 4$	**Ap**	**CO3**
	(OR)		
8 b)	Show that the following vectors are linearly independent: $(1, 2, 0), (2, 3, 4)$ and $(1, 5, -2)$	**Ap**	**CO3**
9 a)	Find whether the following two matrices are similar or not: $A = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \quad B = \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$	**Ap**	**CO3**

	(OR)		
9 b)	Let the vector addition in $\mathbb{R}^2 = \{(x,y)\|x,y \in \mathbb{R}\}$ be defined by$(x_1,y_1)+(x_2,y_2) = (x_1+x_2, y_1+y_2)$. Show that the first five conditions of the vector space related to vector addition are satisfied.	**Ap**	**CO3**
10 a)	Show that $\nabla(f_1 - f_2) = \nabla\varphi_1 - \nabla\varphi_2$.	**R**	**CO4**
	(OR)		
10 b)	Show that $div(\vec{A} - \vec{B}) = div\vec{A} - div\vec{B}$.	**R**	**CO4**
	Group C **Answer All the Questions (7 x 5 = 35)**		
11 a)	(i) Show that $[\vec{a}+\vec{b}\vec{b}+\vec{c}\vec{c}+\vec{a}] = 2[\vec{a}\vec{b}\vec{c}]$ where $\vec{a},\vec{b},$ and$\vec{c}$are any three vectors (ii) Find the value of m for which the vectors $4\hat{\imath}-2\hat{\jmath}+2\hat{k},\ 2\hat{\imath}+4\hat{\jmath}-6\hat{k}$and $3\hat{\imath}+m\hat{\jmath}+5\hat{k}$are coplanar. **3+2**	**R**	**CO4**
	(OR)		
11 b)	Find $div(\vec{F})$ and $curl\ (\vec{F})$ where $\vec{F} = grad(x^3+y^3+z^3-3xyz)$	**R**	**CO4**
12 a)	If $u = \cos^{-1}\left(\frac{x+y}{\sqrt{x}-\sqrt{y}}\right)$, show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + \frac{1}{2}\cot u = 0$	**U**	**CO1**
	(OR)		
12 b)	If $y = e^{m\sin^{-1}x}$, show that $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} - (n^2+m^2)y_n = 0$	**U**	**CO1**
13 a)	If $\vec{r} = (acost)\hat{\imath} + (asint)\hat{\jmath} + (a\ t\ tan\alpha)\hat{k}$, then show that $\left[\frac{d\vec{r}}{dt}\frac{d^2\vec{r}}{dt^2}\frac{d^3\vec{r}}{dt^3}\right] = a^3\tan\alpha$.	**R**	**CO4**
	(OR)		
13 b)	Show that a proper vector $\vec{r}$ has constant length if $\vec{r}.\frac{d\vec{r}}{dt} = 0$.	**R**	**CO4**
14 a)	Find maxima or minima of $f(x,y) = x^3+y^3-3x-12y+20$.	**U**	**CO1**
	(OR)		
14 b)	Evaluate $\int_0^a \int_0^{\sqrt{a^2-y^2}} (x^2+y^2)dxdy$ by changing to polar coordinates.	**Ap**	**CO2**
15 a)	Find the volume generated by revolving the parabola $y^2 = 2ax$ about X-axis bounded by $x = a$.	**Ap**	**CO2**
	(OR)		
15 b)	Find the area of the surface generated by revolving the parabola $y^2 = 2ax$ about X-axis bounded by $x = a$.	**Ap**	**CO2**
16 a)	Express (4,3,10) as linear combination of the vectors $(1,2,0),(2,3,4)$ and $(1,5,-2)$.	**Ap**	**CO3**
	(OR)		
16 b)	Show that the following set of vectors constitute a basis for the vector space $\mathbb{R}^3$with usual vector addition and scaler multiplication: $S = \{(1,1,0),(1,0,1),(0,1,1)\}$	**Ap**	**CO3**
17 a)	Find the eigen values and eigen vectors of the following matrix: $A = \begin{pmatrix} 1 & 1 & 1 \\ -1 & -1 & -1 \\ 0 & 0 & 1 \end{pmatrix}$	**Ap**	**CO3**

	(OR)		
17 b)	Use Cayley-Hamilton theorem to find inverse of the following matrix (if exist): $A = \begin{pmatrix} 1 & 0 & 0 \\ 1 & 2 & 1 \\ 2 & 3 & 2 \end{pmatrix}$	**Ap**	**CO3**

PHY11201	**Applied Science**	L	T	P	C
Version 1.0	**Contact Hours - 45**	3	0	0	3
Pre-requisites/Exposure	12th level Physics, Chemistry, and Mathematics				
Co-requisites	--				

Course Objectives

1. To develop the capability of the students for understanding fundamental aspects of physics.
2. To give students theoretical background, the key prerequisite for performing laboratory experiments.
3. To build up the foundations for further studies in physics and engineering.
4. Learn to analyze and evaluate various thermodynamic cycles used for energy production - work and heat, within the natural limits of conversion
5. To impart the knowledge of measurement of the rate of a chemical reaction and to gain knowledge of electrochemical procedure

Course Outcomes

At the end of the course, the student will be able to:

CO1: Recall the fundamental principles of vector calculus, mechanics, and basic laws of electromagnetism.

CO2: Explain the concepts of modern physics, including quantum mechanics, atomic structure, and nuclear phenomena.

CO3: Apply thermodynamic principles to solve problems involving heat, work, and energy in physical and chemical systems.

CO4: Analyze the kinetics of chemical reactions and determine reaction mechanisms using experimental data.

CO5: Evaluate experimental observations to determine physical parameters such as viscosity, dielectric constant, and Planck's constant.

CO6: Create experimental reports with accurate data analysis and draw conclusions by correlating theoretical concepts with practical outcomes.

Catalog Description

Applied science is a discipline that is used to apply existing scientific knowledge to develop more practical applications, for example: technology or inventions. In applied science different aspects of

Mathematical Physics is used to develop information to explain phenomena in the natural world. This information is then put to use for practical endeavors through a controlled Laboratory environment. Applied science is generally engineering, which develops technology, although there might be dialogue between basic science and applied science (research and development).In this course the focus will be on improving the logical learning moved into a physical environment. Classroom activities will be designed to encourage students to play an active role in the construction of their own knowledge and in the design of their own learning strategies. We will combine traditional lectures with other active teaching methodologies, such as group discussions, cooperative group solving problems, analysis of video scenes and debates. Class participation is a fundamental aspect of this course.

Basic knowledge in chemistry is essential for understanding various energy-work relationships. Student will be able to develop engine. They will be able to increase the efficiency of an engine. Student will understand the different processes in chemical and physical science and their feasibility. The basic knowledge of the molecular structure and their bonding will impart the knowledge of the reactivity and the application of different molecules. The knowledge of electrochemistry will impart a deep sense in preparing different electrochemical cells and their applications. Students will be encouraged to develop new models. We will apply different methodologies to inspire our students combining traditional classes with modern techniques. They will also take part in different project work in fundamental as well as in practical fields.

Course Content

Module 1: Mechanics [10 lecture hours]

Basic ideas of Vector Calculus Potential energy function, Conservative and non-conservative forces. Conservation laws of energy & momentum. Central and non-central forces, Gravitation, Kepler's Laws, Angular Velocity and Torque, Moment of Inertia, SHM, Damped, Undamped and forced Oscillations (no derivations).

Module 2: Optics [5 lecture hours]

Principle of Superposition and Interference from parallel thin films, Single slit and Double slit diffraction, Diffraction grating, dispersive power of Grating, resolving power of prism and grating. production of plane polarized light by different methods, Brewster and Malus Laws. Double refraction, Nicol prism, specific rotation.

Module 3: Electromagnetic Theory [10 lecture hours]

Gauss's Law in Electrostatics, Boundary Value problems, Dielectrics, Motion of Charged Particles in crossed electric & magnetic fields, Velocity Selector & Magnetic focussing, Gauss law, continuity equation, Biot-Savart Law and its applications, inconsistency in Ampere's Law, Maxwell's equations (differential and integral forms), Poynting vector, Poynting Theorem (Statement only).

Module 4: Thermodynamics [10 lecture hours]

Importance and scope, definition of system and surroundings: type of systems (isolated, closed and open); extensive and intensive properties; steady state versus equilibrium state; concept of thermal equilibrium and the zeroth law of thermodynamics; thermodynamic coordinates, state of a system,

equation of state, state functions and path functions; concept of heat and work (IUPAC convention); first law of thermodynamics, internal energy (U) as a state function; enthalpy as a state function; energy conservation in the living organism; heat changes at constant volume and constant pressure; relation between C_p and C_v using ideal gas; Thermodynamics of Chemical Processes, Concept of entropy, 2nd law of thermodynamics, Idea of Chemical potential, Equilibrium conditions for closed systems.

Module 5: Reaction Kinetics, Catalysis & Electrochemistry [10 lecture hours]

Rate laws, 1^{st}Order reaction & 2^{nd}order reaction, Arrhenius equation, Mechanism and Theories of reaction rates, kinetic and thermodynamic control of reaction; idea of rate determining step; steady-state approximation; Characteristics and types of Catalyst, Theories of Catalysis, Electrode potential, Redox reaction & Nernst Equation.

Text Books

1.	Principles of Engineering Physics by S. P. Kuila, (Volume I) New Central Book Agency (P) Ltd.
2.	Principles of Engineering Physics by S. P. Kuila, (Volume II) New Central Book Agency (P) Ltd.
3.	Engineering Physics by Partha Pratim Das and Abhishek Chakraborty
4.	Engineering Physics I by S. K. Bhattacharya and Soumen Pal
5.	Engineering Physics II by S. K. Bhattacharya and Soumen Pal
6.	Engineering Chemistry (Cambridge University Press-IstEdition) –Shikha Agarwal
7.	P. W. Atkins, Physical Chemistry, ELBS/Oxford, 10th Edition, 2014

Reference Books

1.	Optics by Ajoy Ghatak, Mc-graw Hill
2.	Introduction to Electrodynamics, David J. Griffiths, Pearson Education Limited
3.	Engineering Chemistry (Pearson Ed.)- K. Sesha Maheswaramma and MridulaChugh
4.	Physical Chemistry (Sarat Book House)- P. C. Rakshit

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	**50**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Name:		Applied Science						Course Code:		PHY13201					
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	1	0	0	0	0	0	0	0	0	0	1	0	0	0
CO2	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0
CO3	3	3	0	0	0	0	0	0	0	0	0	1	0	0	0
CO4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO5	3	2	0	0	0	0	0	0	0	0	0	1	0	0	0
CO6	3	2	0	0	0	0	0	0	0	0	0	1	0	0	0
Average	3	2	0	0	0	0	0	0	0	0	0	1	0	0	0

1=weakly mapped
2= moderately mapped
3=strongly mapped

Model Question Paper

ADAMAS UNIVERSITY PURSUE EXCELLENCE	**ADAMAS UNIVERSITY** **END SEMESTER EXAMINATION** (Academic Session: 2021 – 2022)		
Name of the Program:	B.Tech	**Semester:**	I
Paper Title:	Applied Science	**Paper Code:**	PHY11201
Maximum Marks:	50	**Time Duration:**	3 Hrs
Total No. of Questions:	17	**Total No of Pages:**	

4. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
5. All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
6. Assumptions made if any, should be stated clearly at the beginning of your answer.

Group A
Answer All the Questions (5 x 1 = 5)

1	**Define** polarization of light.	**R**	**CO2**
2	**State** Faraday's law of Electromagnetic induction.	**R**	**CO3**
3	**Define** Gauss's divergence theorem.	**R**	**CO1**
4	**Define** internal energy of a thermodynamics system	**R**	**CO4**
5	**State** Arrheniusrelation between rate constant and temperature	**R**	**CO5**

Group B **Answer All the Questions (5 x 2 = 10)**			
6 a)	A cubical block of side L and density d is floating in a water of density ρ(ρ>d). The block is slightly depressed and released. **Show that** it will execute simple harmonic motion and hence **determine** the frequency of oscillation.	**Ap**	**CO1**
(OR)			
6 b)	**Explain** Maxwell's modification on Ampere's law.	**Evaluate**	**CO3**
7 a)	Show that $C_P - C_V = [p + \left(\frac{\delta U}{\delta V}\right)_T]\left(\frac{\delta V}{\delta T}\right)_P$. Hence find the value for an ideal gas. Comment on the value of (C_P-C_V) for a solid or a liquid.	**Ap**	**CO4**
(OR)			
7 b)	(a)When order and molecularity of reaction can be same? (b) Why does order can be fractional but molecularity cannot? (c) Write the units of rate constants for zero and second order reaction.	**U**	**CO5**
8 a)	What is the value of a for which the following system of equations has unique solution? $x + y + z = 1$ $x + 2y - z = 2$ $5x + 7y + az = 4$	**Ap**	**CO3**
(OR)			
8 b)	In an interference experiment,'d' is the distance between the two coherent sources of light with wavelength λ and D is the distance between source to screen. **Show** that the separation between the two consecutive dark bands is given by β=λD/d	**Ap**	**CO3**
9 a)	Find whether the following two matrices are similar or not: $A = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \quad B = \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$	**Ap**	**CO3**
(OR)			
9 b)	Let the vector addition in $\mathbb{R}^2 = \{(x, y) \mid x, y \in \mathbb{R}\}$ be defined by$(x_1, y_1) + (x_2, y_2) = (x_1 + x_2, y_1 + y_2)$. Show that the first five conditions of the vector space related to vector addition are satisfied.	**Ap**	**CO3**
10 a)	Show that $\nabla(f_1 - f_2) = \nabla\varphi_1 - \nabla\varphi_2$.	**R**	**CO4**
(OR)			
10 b)	Show that $div(\vec{A} - \vec{B}) = div\vec{A} - div\vec{B}$.	**R**	**CO4**
Group C **Answer All the Questions (7 x 5 = 35)**			
11 a)	Show that $C_P - C_V = [p + \left(\frac{\delta U}{\delta V}\right)_T]\left(\frac{\delta V}{\delta T}\right)_P$. Hence find the value for an ideal gas. Comment on the value of (C_P-C_V) for a solid or a liquid.	**U**	**CO2**
(OR)			
11 b)	a)When order and molecularity of reaction can be same? (b) Why does order can be fractional but molecularity cannot? (c) Write the units of rate constants for zero and	**R**	**CO4**

	second order reaction		
12 a)	In Newton's Rings experiment the diameter of the 5th dark ring is 0.336 cm. and the diameter of the 15th dark ring is 0.590 cm. **Find** the radius of the plano-convex lens if the wavelength of the light used is 5890 A.	**U**	**CO1**
	(OR)		
12 b)	In an interference experiment,'d' is the distance between the two coherent sources of light with wavelength λ and D is the distance between source to screen. **Show** that the separation between the two consecutive dark bands is given by β=λD/d.	**U**	**CO1**
13 a)	**Find** out the condition for maximum and minimum intensity in Young's Double slit experiment for Interference of Light. **Show** that Energy remains constant in this phenomenon.	**R**	**CO4**
	(OR)		
13 b)	Five equal charges of 40 nC each are placed at five vertices of a regular hexagon of 6 cm side. The sixth vertex is free. **Determine** the electric field at the centre of the hexagon due to the distribution.[	**R**	**CO4**
14 a)	**Compare** the electrostatic force and Gravitational force between a proton and electron in a hydrogen atom. Given $e = 1.6 \times 10^{-19}c, m_e = 9.1 \times 10^{-31}kg, m_p = 1.7 \times 10^{-27}kg \; and \; G = 6.67 \times 10^{-11}Nm^2kg^{-2}$.	**U**	**CO1**
	(OR)		
14 b)	**Derive** equation of continuity for current. **Show** that for steady current it reduces to $\nabla.\vec{J}=0$.	**Ap**	**CO2**
15 a)	I mole of an ideal gas is allowed to expand freely under adiabatic condition to double of its volume. The initial temperature of the gas is 300 K and the initial pressure is 1 atm. Find the final temperature, final pressure of the gas. Also calculate □U+□H for the process.	**Evaluate**	**CO2**
	(OR)		
15 b)	Show that PV□= constant for an adiabatic process of a gas. State all the assumptions.	**U**	**CO2**
16 a)	$dU=C_V\,dT$ Is this valid for all systems? State the conditions under which the equation is valid.	**U**	**CO3**
	(OR)		
16 b)	What is the significance of activation energy?	**U**	**CO3**
17 a)	Initial rate of a first order reaction increases three-fold when temperature changes from 400 K to 420 K. If the half-life period of the reaction at 400 K is 10 min, calculate the time required for 20 % conversion of the reactant at 420 K and the activation energy**.**	**Evaluate**	**CO-4**
	(OR)		
17 b)	What effect does temperature has on the rate of chemical reactions? Explain it on the basis of Arrhenius equation.	**U**	**CO-5**

CSE11001	**Introduction to Programming**	L	T	P	C
Version 1.0	**Contact Hours - 45**	3	0	0	3
Pre-requisites/Exposure	10+2 Level Mathematics, Knowledge of Basics of Computer				
Co-requisites	Knowledge of Logical Reasoning and Analysis				

Course Objectives

1. To understand the nature of programming as human activity.
2. To practice the programming construct to solve multi-dimensional problems.
3. To relate and implement mathematical concepts through programming in order to solve computational problems.
4. To enable students to acquire structure and written expression required for their profession.
5. To understand the principles of data storage and manipulation.

Course Outcomes

On completion of this course, the students will be able to

CO 1 Remember basics concepts of programming structure and implement the basics concepts of Programming.
CO 2 Understand various problems using programming language and select the best solution.
CO 3 Apply modularized solution and design such programs to appraise the solution
CO 4 Analyze the basic usage of memory and construct such memory in terms of array in a program.
CO5. Evaluate different data structures for various collection of data.
CO6. Create a 'C program' to solve a real life problem

Catalog Description

Programming skills are mandatory for designing or solving problems through digital device. It is the language through which computational/digital devices are communicated rather interfaced. To develop any software programming language is a must. In present era almost all aspect of life is somehow largely related to virtualization and digital data/information. Devices from smartphones to other handheld devices, drones, cameras, medical instruments etc. all needs programming at some part. In engineering it has become quintessential for the students/research scholars to learn programming. In this course, students will learn how to solve problems in various domains through a programming language. This course enables students with the basic skills of C Programming Language. Five Different related modules comprise this course. First Unit familiarizes students with basics of computers, algorithmic method to solve problem, introduction to generic programming construct. Basics of C Programming is upto iterative structure is depicted in Unit II. In Unit III students will learn about modularization using functions and one advance concept of C Programming, Pointers. Unit IV will cover one of the most important concepts in C Programming, Array and Strings. Unit V will accomplish this course with the advance concept like Structure, Union and File Handling. After this course students will grow their analytical ability to solve problem and logical skill. Also, this course effectively creates the ability to grasp any other Programming Language in easier manner.

Course Content

Unit I: 4 lecture hours

Basic Concepts of Programming: Introduction to components of a Computer System (disks, memory, processor, where a program is stored and executed, operating systems, compilers, etc.), Idea of Algorithm: steps to solve logical and numerical problems, Representation of Algorithms: Flowchart/Pseudo code with examples, From Algorithms to Programs; source code, variables and memory locations, Syntax and Logical Errors in compilation, Object and Executable code

Unit II: 10 lecture hours

Basics of C Programming : Characters used in C, Identifiers, Keywords, Data type & sizes, Constants &Variables, Various Operators used such as Arithmetic Operators, Relational & Logical Operators, Increment & Decrement Operators, Assignment Operators, Conditional or Ternary Operators, Bitwise Operators & Expressions; Standard Input & Output, formatted input scanf( ), formatted output printf( );

Flow of Control, if-else, switch-case, Loop Control Statements, for loop, while loop, do-while loop, nested loop, break, continue, goto, label and exit( ) function

Unit III: 10 lecture hours

Functions and Pointers: Definition of Function, Declaration or Prototype of Function, Various types of Functions, Call by Value, Call by Reference, Recursion, Tail Recursion, Definition of Pointer, Declaration of Pointer, Operators used in Pointer, Pointer Arithmetic, Functions with Pointer

Unit IV 17 lecture hours

Arrays and String: Definition, Single and Multidimensional Arrays, Representation of Arrays - Row Major Order, and Column Major Order, Application of arrays – searching and sorting, Sparse Matrices and their representations. Definition of a String, Declaration of a String, Initialization of a String, Various String Handling Functions with example

Structures and Unions: Definition of a Structure, Declaration of a Structure & Structure Variable, Initialization of a Structure, Operators used in Structure, Structure within Structures, Union, Difference between a Structure and a Union

Files: Types of File, File Processing, Handling Characters, Handling Integers, Random File Accessing, Errors During File Processing

Unit V 4 lecture hours

Overview of Stacks and Queues: Introduction to Stack, Primitive operations on Stack, Real-life applications of Stack, Introduction to Queues, Primitive operations on Queues, Real-life applications of Queues.

Text Books

1. Balagurusamy, E., n.d. Programming In ANSI C. 5th ed. Bangalore: mcgraw-hill.
2. Gotfreid (196) *Schaum's Outline of Programming with C*, 2 edn., USA: McGraw-Hill
3. Brian W. Kernighan, Dennis Ritchie (1988) *C Programming Language*, 2 edn., : Prentice Hall.

Reference Books

1. Al Kelley, Ira Pohl (1988) *A Book on C*, 4 edn., : Addision Wesley Longman**.**

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Name:		Introduction to Programming						Course Code:		CSE11001					
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	0	1	0	0	0	0	0	1	0	0	0	0
CO2	3	2	2	0	1	0	0	0	0	0	1	0	0	0	0
CO3	3	2	2	0	1	0	0	0	0	0	1	0	0	0	0

CO4	3	2	2	0	1	0	0	0	0	0	1	0	0	0	0
CO5	3	2	2	0	1	0	0	0	0	0	1	0	0	0	0
CO6	3	2	2	0	1	0	0	0	0	0	1	0	0	0	0
Average	3	2	2	0	1	0	0	0	0	0	1	0	0	0	0

1=weakly mapped

2= moderately mapped

3=strongly mapped

Model Question Paper

ADAMAS UNIVERSITY PURSUE EXCELLENCE	**ADAMAS UNIVERSITY** **END SEMESTER EXAMINATION** (Academic Session: 20-- – 20--)		
Name of the Program:	B.Tech	**Semester:**	I
Paper Title:	INTRODUCTION TO PROGRAMMING	**Paper Code:**	**CSE11001**
Maximum Marks:	50	**Time Duration:**	3 Hrs
Total No. of Questions:	17	**Total No of Pages:**	

7. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
8. All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
9. Assumptions made if any, should be stated clearly at the beginning of your answer.

	Group A **Answer All the Questions (5 x 1 = 5)**		
1	**What** do you understand data types?	**U**	**CO1**
2	**Define** array?	**U**	**CO4**
3	**How** user defined function reduces the no. of lines in a large program?	**R**	**CO2**
4	**Why** pointer is advantageous than array?	**U**	**CO5**
5	**What** is the size of an integer variable?	**R**	**CO1**
	Group B **Answer All the Questions (5 x 2 = 10)**		

6 a)	**What** is dimension of an array?**How** many types of array are there?	**U**	**CO1**
	(OR)		
6 b)	Can you store integer values and float type values in a single array, if not **why**?	**U**	**CO1**
7 a)	**What** you need to do to store such different types of values in an single array?	**R**	**CO2**
	(OR)		
7 b)	**Find** an user defined function in c that would return multiple values in main() function	**Ap**	**CO2**
8 a)	State the types of data types and memory occupies.	**U**	**CO3**
	(OR)		
8 b)	Show that the following vectors are linearly independent: $(1, 2, 0), (2, 3, 4)$ and $(1, 5, -2)$	**Ap**	**CO3**
9 a)	**What** are the ways to convert from one data type to another data type with suitable example?	**U**	**CO2**
	(OR)		
9 b)	**What is the use of FOR…NEXT Loop?**	**R**	**CO3**
10 a)	**Define String constants.**	**R**	**CO4**
	(OR)		
10 b)	How many statements are there in this line of code: print("If I am 17, I can drive a car")?	**R**	**CO4**
	Group C **Answer All the Questions (7 x 5 = 35)**		
11 a)	**Design** a program to create a pointer to an integer. Allocate memories for 60 elements into that pointer using both malloc() and calloc() function. Display the significance difference of using those two functions to allocate memory. Also state the specific needs of these two functions.	**R**	**CO4**
	(OR)		
11 b)	Suppose a paragraph is stored in a 2-D character array. **Find** a specific sentence in that paragraph using a c program.	**U**	**CO4**
12 a)	**How** is it possible to take input in a 2-D array using a single for loop? Make it possible using a suitable program in c.	**U**	**CO4**
	(OR)		
12 b)	**Design** a program in c to determine that a text is written in English or in any other language. If the text is written in any other language convert every character in its nearest English alphabets.	**Ap**	**CO5**
13 a)	**Using** pointer write a function that will calculate maximum and minimum of a given set of numbers.	**R**	**CO4**
	(OR)		
13 b)	Write a program to arrange a group of numbers into positive & negative numbers.	**R**	**CO4**
14 a)	What is loop ? Discuss the different types of loops with syntax and appropriate examples. Write a program to print the summation of the following series : ! 1 + 1 22 + 1 32 + 1 42 + ... + 1 N2 .	**AP**	**CO5**
	(OR)		
14 b)	Explain strcat ( ), strcmp ( ), strrev ( ), strlen ( ) and Write a recursive function that will calculate HCF of two numbers.	**Ap**	**CO2**
15 a)	What is structure ? How does a structure differ from any array ? What do you mean by	**U**	**CO2**

	call by value and call by reference ? Write a C program, which accepts an integer numbers and prints the multiplication of the digits.		
	(OR)		
15 b)	Write a program to check whether a given string palindrome or not. What do you mean by scope of a variable ? Explain the storage classes available in C.	**Ap**	**CO2**
16 a)	Explain the difference between structure & union with examples. 4 b) What is Pointer ? Using pointer write a program to find out length of the given string without using strlen ( ) function.	**R**	**CO3**
	(OR)		
16 b)	What do you mean by Recursion ? Give example. What are strings ? Explain with example. Explain the difference between structure & union with examples. What is Pointer ?	**Ap**	**CO3**
17 a)	What is a function ? What do you mean by the following : i) Function declaration ii) Function calling iii) Function definition.	**U**	**CO3**
	(OR)		
17 b)	**Design** a program to create a pointer to an integer. Allocate memories for 50 elements into that pointer using both malloc() and calloc() function. Display the significance difference of using those two functions to allocate memory. Also state the specific needs of these two functions.	**Ap**	**CO4**

ENG11053	**English Communication**	L	T	P	C
Version 1.0	**Contact Hours - 45**	3	0	0	3
Pre-requisites/Exposure	12th level English				
Co-requisites	--				

Course Objectives

1. To know the importance and techniques of communication skills in order to improve professional skills
2. To enhance the knowledge of the students on vocabulary, syntax, and grammatical skills
3. To improve writing skills by applying writing techniques, tools in practice sessions
4. To achieve an overall enhancement in terms of reading, listening and speaking

Course Outcomes:

On completion of this course, the students will be able to

CO1. **CO1. To have a basic understanding of communication processes and to know the practical implications and its challenges at the workplace**

CO2. To know the practical uses of English grammar and to use grammar correctly and unambiguously
CO3. To be familiar with different formats of business communication like reports, letters, and other technical writings
CO4. To acquire competence in speaking,reading,listening,and writing in English.
CO5. To be familiar with English pronunciation and use neutral accent successfully
CO6. To be able to comprehend different other accents of spoken English

Catalog Description

Effective communication is one of the basic requirements of a successful career. Both verbal and nonverbal communication is important to exchange ideas among the employees within the organisation and outside the organisation as well. In this course, the focus will be on improving LSRW skills, i.e. listening, speaking, reading and writing. Students will learn how to communicate effectively through prescribed syllabus. Classroom activities will be designed to encourage students to play an active role in the construction of their own knowledge and in the design of their own learning strategies. We will combine traditional lectures with other active teaching methodologies, such as group discussions, role play, small skit enactments, analysis of video scenes and debates. Class participation is a fundamental aspect of this course. Students will be encouraged to actively take part in all group activities and to give an oral group presentation. Students will be expected to interact with media resources, such as, web sites, videos, DVDs, and newspapers etc.

Course Content

Module I: **9 lecture hours**
Communication Level 1: Basics of Communication, Means of Communication, Barriers of Communication

Module II: **9 lecture hours**
Grammar and Syntax Level 1: Tense: types and uses, Idioms, One Word Substitutes, Discussion on the use of Articles and related exercises, Discussion on the use of Prepositions and related exercises, Exercises on Sentence –Making (Syntax), Practice exercises on Voice change, Class Exercises on Synonyms and Antonyms.

Module III: **9 lecture hours**
Reading and Listening Skills Level 1: Introduction to listening skills: purposes and practice, Discussion on types of listening: difference between listening and hearing, Active listening: introduction listening exercises, Elementary level listening exercise, Intermediate level listening exercise, Advance level listening exercise, Introduction to Reading Skills, Strategies of reading, Skimming, Scanning and Summarizing, Comprehension exercises.

Module IV: **9 lecture hours**

Speaking Skills Level 1: Introduction to Speaking Skills: Mother tongue influence, Discussion on various kinds of narrative styles and techniques: Welcome speech, Vote of Thanks, Farewell Speech, Debate and Elocution, Class Exercises on Descriptive narration, Practical Exercises on Narration styles, Presentation of small skits, Practicing Extempore in the class, Mock practices of Group discussion, Practicing speaking in pairs, Mock practice of job interviews.

Module V: **9 lecture Hours**

Writing Skills Level 1: Business letters: definition, types and format, Practice exercises, Business reports: definition, types and format, Practice exercises, CV and Application letters: types and formats, Practice exercises, Compositions: Essays, precis paragraph writing

Text Books:

1.Kaul Asha. Effective Business Communication. PHI Learning Pvt Ltd. 2014.
2.Wren and Martin. High School Grammar And Composition. S. Chand, 1995.
3.Gupta, A. English Reading Comprehension. Ramesh Publishing House, 2009.

Reference Book:

1.Lewis, Norman. Word Power Made Easy. Anchor: 2014.
2.Riordan, Daniel G & Pauley Steven A. :Technical Report Writing Today. 2004.
3.Hamp-Lyons and Heasely, B . Study Writing; A Course in Written English. For Academic and Professional Purposes, Cambridge Univ. Press, 2006.
4.Quirk R., Greenbaum S., Leech G., and Svartik, J. A Comprehensive Grammar of the English language, Longman:London, 1985.
5.Balasubramaniam, T. A Textbook of English Phonetics for Indian Students. Macmillan: 2012.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Name:		English Communication			Course Code:		ENG11053					

CO/PO	PO 1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
CO2	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0
CO3	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
CO4	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
CO5	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
CO6	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0
Average	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0

1=weakly mapped
2= moderately mapped
3=strongly mapped

Model Question Paper

ADAMAS UNIVERSITY PURSUE EXCELLENCE	**ADAMAS UNIVERSITY** **END SEMESTER EXAMINATION** (Academic Session: 2021 – 2022)		
Name of the Program:	B.Tech	**Semester:**	I
Paper Title:	**HSSM –I (English Communication- I)**	**Paper Code:**	ENG11053
Maximum Marks:	50	**Time Duration:**	3 Hrs
Total No. of Questions:	17	**Total No of Pages:**	

10. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
11. All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
12. Assumptions made if any, should be stated clearly at the beginning of your answer.

Group A
Answer All the Questions (5 x 1 = 5)

1	**Where** were you ___ 28 February, 2019? (Fill in the blank with appropriate preposition)	**R**	**CO2**
2	**What** is non-verbal communication?	**R**	**CO3**
3	**Find** one word substitute for: "One who loves books"	**R**	**CO1**
4	**What** is the antonym of "Happiness"?	**R**	**CO4**
5	Give example of an idiom.	**R**	**CO5**
Group B **Answer All the Questions (5 x 2 = 10)**			
6 a)	**What** are the barriers to communication? **Explain** some physical and psychological barriers of communication	**Ap**	**CO1**
(OR)			
6 b)	**What** do you understand by communication? Write a note on the importance of effective communication.	**Evaluate**	**CO3**
7 a)	How Communication is important in media and journalism?	**Ap**	**CO4**
(OR)			
7 b)	Fill in the blanks using suitable article. **Find** a copy the sentences given, while answering: i. He was ____ first man to arrive. ii. Would you like to be _____ teacher? iii. I am going to buy _____ hat. iv. Picasso was ____ famous painter. v. The Ganga is ____ sacred river.	**U**	**CO5**
8 a)	Differentiate active and effective listening.	**R**	**CO3**
(OR)			
8 b)	Discuss Advance level listening exercise	**U**	**CO3**
9 a)	Presentation of small skits.	**R**	**CO4**
(OR)			
9 b)	Let the vector addition in $\mathbb{R}^2 = \{(x, y)\|x, y \in \mathbb{R}\}$ be defined by$(x_1, y_1) + (x_2, y_2) = (x_1 + x_2, y_1 + y_2)$. Show that the first five conditions of the vector space related to vector addition are satisfied.	**Ap**	**CO3**
10 a)	Show that $\nabla(f_1 - f_2) = \nabla\varphi_1 - \nabla\varphi_2$.	**R**	**CO4**
(OR)			
10 b)	Show that $div(\vec{A} - \vec{B}) = div\vec{A} - div\vec{B}$.	**R**	**CO4**
Group C **Answer All the Questions (7 x 5 = 35)**			

11 a)	**Change** the following sentences from active to passive voice: i. The cat killed a mouse ii. People lined the road iii. He was singing a song yesterday iv. I have read this book. v. Who broke the jug?	**U**	**CO2**
	(OR)		
11 b)	**Compose** a paragraph on the impact of COVID 19 in our society.	**R**	**CO4**
12 a)	**Compose** an application to the Vice-Chancellor of your University as the class representative of your respective class requesting permission to organize a science exhibition in your department	**U**	**CO1**
	(OR)		
12 b)	Read the following passage and **find** the answer the questions that follow. A few countries already use powerful electromagnets to build high speed trains. These trains are called maglev trains. Maglev is the shortened form of magnetic levitation. Maglev trains work on the principles of magnetism and float over a guideway. The maglev train is different from a conventional train in that it does not have an engine. At least it does not have the kind of engines that pull train cars along steel tracks. It does not consume fossil fuels either. Since maglev trains float in the air, there is no friction between the train and the track. This lack of friction and the aerodynamic design of these trains allow them to reach speeds of over 500 kilometer per hour. Japan and Germany pioneer research in the maglev train technology. They have already built their prototypes and are in the process of testing them. Transrapid is an electromagnetic suspension system developed by German engineers. The idea of maglev transportation has been in existence for over a century. The first commercial maglev train made its debut in Shanghai, China in 2002. This train was developed by a German company. Right now the Shanghai Transrapid line connects Longyang Road station and Pudong airport. China is planning to extend this line to Hangzhou by building a 99 miles guideway. Several other countries are also planning to build their own maglev train system, but right now the Shanghai maglev train is the only commercial maglev line. Complete the sentences: (2×5=10) (a) The two main differences between maglev trains and conventional trains are: ……..., …….. (b) Maglev trains are environment friendly because ……	**U**	**CO1**

	(c) The two nations that lead the research in maglev train technology are …….. (d) The two factors that help maglev trains to achieve high speeds are ……. (e) A suitable title for the passage would be …….		
13 a)	Write a report based on final year project details.	**R**	**CO4**
	(OR)		
13 b)	Write a suitable CV while you are applying for a suitable job.	**R**	**CO4**
14 a)	**Change** the following sentences from active to passive voice: i. The mouse killed a snake ii. People lined the road iii. She was singing a song yesterday iv. I have read this book. v. Who broke the mug?	**U**	**CO1**
	(OR)		
14 b)	Discuss on the use of Prepositions and Class Exercises	**U**	**CO2**
15 a)	Differentiate listening and hearing	**Evaluate**	**CO2**
	(OR)		
15 b)	Explain Intermediate level listening exercise, Advance level listening exercise	**U**	**CO2**
16 a)	Discuss on Class Exercises on Synonyms and Antonyms.	**U**	**CO3**
	(OR)		
16 b)	**Compose** a paragraph on the impact digital learning in our Education.	**U**	**CO3**
17 a)	**Compose** an application to the Principal of your University as the class representative of your respective class requesting permission to organize a science exhibition in your department	**Evaluate**	**CO-4**
	(OR)		
17 b)	Japan and Germany pioneer research in the maglev train technology. They have already built their prototypes and are in the process of testing them. Transrapid is an electromagnetic suspension system developed by German engineers. The idea of maglev transportation has been in existence for over a century. The first commercial maglev train made its debut in Shanghai, China in 2002. This train was developed by a German company. Right now the Shanghai Transrapid line connects Longyang Road station and Pudong airport. China is planning to extend this line to Hangzhou	**U**	**CO-5**

	by building a 99 miles guideway. Several other countries are also planning to build their own maglev train system, but right now the Shanghai maglev train is the only commercial maglev line. Complete the sentences: (2×5=10) (a) The two main differences between maglev trains and conventional trains are: ……..., …….. (b) Maglev trains are environment friendly because ……		

GEE11012	**Disruptive Technologies**	**L**	**T**	**P**	**C**
Version 1.0		**2**	**0**	**0**	**2**
Pre-requisite/Exposure					
Co-requisite					

Course Objectives:

1. Understand the fundamentals of Artificial Intelligence (AI) and Machine Learning (ML)
2. Explore the role of data in Machine Learning
3. Introduction to Natural Language Processing (NLP)
4. Examine the impact of AI on various industries.
5. Introduction to Data Analytics

Course Outcomes:

On the completion of this course the student will be able to

CO1. Articulate a clear and comprehensive definition of the concept of disruptive technology through the analysis of a number of disruptive technology cases;
CO2. Describe both the common, and distinctive characteristics of specific disruptive technologies within a range of contexts;
CO3. Apply and analyze the social, financial and technological conditions that support or prevent the advent and/or implementation of a disruptive technology;
CO4. Assess and enact the power of collaboration, user feedback, and other team approaches to creative ideation and innovation;
CO5. Draw connections between the concepts associated with disruptive technologies to envision and evaluate a new disruptive technology; and
CO6. Synthesize individual research and visually present original ideas by creating a multimedia digital slide presentation.

Course Description:

The course on Disruptive Technologies aims to provide students with an in-depth understanding of various cutting-edge technologies that are reshaping industries and revolutionizing traditional practices. Through a comprehensive curriculum spanning six units, students will delve into Artificial Intelligence/Machine Learning (AI/ML), Data Analytics, Internet of Things (IoT), Cybersecurity, Robotic Process Automation (RPA), and Additive Manufacturing (AM) and Rapid Prototyping (RP).

Course Content:

Disruptive Technologies

Unit 1: AI/ML Lecture:10

AI/ML: Introduction to Artificial Intelligence; Definition and applications of AI; Importance and impact Of AI in various industries; Machine Learning basics; Distinction between AI and ML; Types of Machine Learning - Supervised, Unsupervised, Reinforcement; Role of data in Machine Learning; Evaluation metrics in ML; Case study of AI implementation in Healthcare and Manufacturing industry; Challenges in AI adoption; Ethics and bias in AI.

NLP: Basics of Natural Language Processing (NLP); Why is NLP required; Text preprocessing and tokenization, Basic sentiment analysis, Applications of NLP in real-world scenarios

Generative AI & Large Language Models: Introduction to generative AI, What are Large Language Models,

Unit 2: Data Analytics with Tools: Lecture:6

Data Analytics: Introduction to Data Analytics; Importance of data in decision-making in industries; Types of Analytics – Descriptive, Prescriptive, Predictive and Preventive; Types of data (Structured / Unstructured); Overview of popular tools MS Excel, R, Tableau &PowerBI

Data collection and preprocessing: Data collection methods; Data cleaning and quality assessment; Dealing with missing data; Data transformation and feature engineering,

Unit 3: IOT Lecture:10

Introduction to IoT: Definition and concept of the Internet Of Things; Significance and impact on various industries; IoT architecture and components overview (Sensors, Actuators, Microcontrollers); Types of sensors (Temperature, Humidity, Motion, Etc.); Sensor characteristics and selection criteria, Actuators and their role in IoT systems; Basics of Arduino and Raspberry Pi.

IoT Applications: Healthcare, Remote Patient Monitoring, Wearable Health Monitoring Devices, Smart Cities, Agriculture and Environmental Monitoring; Basics of Augmented Reality (AR) and Virtual Reality (VR); Digital twins in IoT.

Unit 4: Cyber Security Lecture:9

Introduction to Cybersecurity: Definition and scope; Cyber threats and the need for protection of business data; Overview of common cyber threats (Malware, Phishing, Ransomware, Trojans, Worms); Social engineering as a means for attacks and prevention; Confidentiality, Integrity and Availability (CIA) triad.

Risk Assessment and Management: Security policies and procedures; Best practices.

Security Technologies and Tools: Antivirus software, Firewalls and Intrusion Detection / Prevention Systems (IDS / IPS); Encryption and secure communication; Overview of network security; Steganography and Cryptography.

Unit 5: Robotics and Automation Lecture:6

Robotics and Automation: Types of robots and their applications; Role of automation in various industries; Current trends and future prospects; Robot anatomy and components - DC Motors, Servos, Stepper Motors; Types of robotic end-effectors / Grippers; Pick-and-place operations; Safety considerations and standards.

Applications of Robotics: Cobots (Collaborative Robots), Soft Robotics, Swarm Robotics, Bio-inspired Robotics, Industry 4.0 and Smart Factories.

Unit 6: **Additive Manufacturing (AM) And Rapid Prototyping (RP)** Lecture:6

Basic Principles: Definition and comparison with traditional manufacturing methods; Applications and benefits of AM and RP; Applications - Aerospace and automotive industries, Medical and healthcare applications, Consumer goods and electronics; Challenges of AM and RP

Materials: Plastics, Metals, Ceramics, Composites, Biological Materials

Technologies: Stereolithography (SLA), Fused Deposition Modelling (FDM), Selective Laser Sintering (SLS), Electron Beam Melting (EBM), Polyjet Printing, Binder Jetting, Direct Metal Laser Sintering (DMLS)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	0	0	0	3	0	0	0	0	0	3	0	0	0
CO2	0	0	0	0	0	3	0	0	0	0	0	3	0	0	0
CO3	0	0	0	0	0	3	0	0	0	0	0	3	0	0	0
CO4	0	0	0	0	0	3	0	0	0	0	0	3	0	0	0
CO5	0	0	0	0	0	3	0	0	0	0	0	3	0	0	0
CO6	0	0	0	0	0	3	0	0	0	0	0	3	0	0	0
Average	0	0	0	0	0	3	0	0	0	0	0	3	0	0	0

BIT11003	**Life Science**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hours - 45**	3	0	0	3
Pre-requisites/Exposure	Class 12 Biology				
Co-requisites	--				

Course Objectives:

1. To acquire the knowledge about the cell structure and interaction with neighboring cells in biological system.
2. To gain the knowledge about the genetic switches and oscillators and evolutionary dynamics.
3. To acquire the knowledge about the transport of molecules in different cellular compartments.
4. To gain the knowledge about dynamics of different systems in human body.
5. To understand the application and significance of different techniques of medical biotechnology.

Course Outcomes for SBT41108

At the end of the course, the student will be able to:

CO-1 Remember the structure and functions cell organelles and their interrelationship.

CO-2 Understand the genetic switches and evolutionary dynamics of living system.

CO-3 Examine the mode of transport of molecules in biological system numerically.

CO-4 Analyze the different networks of human body and other physiological systems and can summarize consequences of physiological disorders.

CO-5 Review different techniques of medical biotechnology on human body to analyse the malfunction of different human system during diseased conditions.

CO6 Devise a moral code of conduct for various scientific practices

Course Description:

Cell is the structural and functional unit of living organism, it is well known throughout the universe, but mystery the molecular mechanism for performing the different kinds of functions of cell organelle (along with their development in both plant and animal system) and their integration into a beneficial outcome for living organism and as well as the outcome of physiological responses is almost unknown. So the course consists of structure function relationship of cell organelles, trafficking of different molecules between different cellular compartments and their secretion, creation of physiological responses and their assessment by several kinds of instrumentation techniques which can create a common platform between science of engineering and biological science.

Course Content:

Unit I: Cell biology & Communication: [7 hours lecture]

Structure, function, and synthesis of cellular membranes and organelles; cell growth and cancer; cytoskeleton and extracellular matrix; cell cycle; transport, receptors, and cell signaling; functions of specialized cell types.

Unit II: Genetics & Systems Biology [4 hours lecture]

Genetic switches and oscillators, cell-to-cell interactions, cellular and genetic networks, and evolutionary dynamics.

Unit III: Transport & Flow in Biological Systems [7 hours lecture]

Diffusion, osmosis, facilitated, and active transport; Heat Conduction and Radiation; Fluid Dynamics; Heat and Mass Transfer. Electromechanical and physicochemical interactions in cells and biomaterials.

Unit IV: Human Physiology & Diseases [10 hours lecture]

Anatomical, physiological and pathological features of the cardiovascular, respiratory and renal systems. Identifications of deficiencies and diseases from blood, urine and feces; genetic disorders and gene therapy.

Unit V: Neurophysiology [10 hours lecture]

Neuron structure and function; Regeneration of nerve; flow and transport of signals from one neuron to other; Nervous system; Aging and its effect on brain; Behavioral functions of the brain - emotion, memory, learning and consciousness; Disorders of the nervous system and treatment.

Unit VI: Medical Biotechnology [7 hours lecture]

Understanding the handling and usefulness of electrocardiograms, ultrasound images, X-ray images, magnetic resonance images (MRI), computerized tomography (CT) or computerized axial tomography (CAT) images, glucose sensors, and other biosensors.

Text Books

1. Biology for Engineers by Arthur T. Johnson. CRC Press, 1 edition, 2010.
2. New Biology for Engineers and Computer Scientists by AydinTozeren and Stephen W. Byers. Pearson, 1 edition, 2003.

Reference Books

1. Applied Cell and Molecular Biology for Engineers by Gabi Nindl Waite and Lee R. Waite. McGraw-Hill Education, 1 edition, 2007.
2. Samson Wright's Applied Physiology.

Modes of Examination: Assignment/Quiz/Project/Presentation/Written Exam
Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Name:		Life sciences					Course Code:		BIT11003					
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	0	1	1	1	0	1	0	0	0	0
CO2	0	0	2	0	0	1	1	0	0	0	1	0	0	0	0
CO3	2	1	1	2	1	1	0	1	0	1	1	0	0	0	0
CO4	1	1	2	0	1	2	0	3	2	2	1	2	0	0	0
CO5	0	1	1	0	1	2	0	2	3	3	1	2	0	0	0
CO6	0	1	1	0	1	2	0	2	3	3	1	2	0	0	0
Average	1	1	1	2	1	2	1	2	3	3	1	2	0	0	0

1=weakly mapped
2= moderately mapped
3=strongly mapped

Model Question Paper

	ADAMAS UNIVERSITY **END SEMESTER EXAMINATION** (Academic Session: 2021 – 2022)		
Name of the Program:	B.Tech	**Semester:**	I
Paper Title:	Life Science	**Paper Code:**	BIT11003
Maximum Marks:	50	**Time Duration:**	3 Hrs
Total No. of Questions:	17	**Total No of Pages:**	

1. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
2. All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

Group A
Answer All the Questions (5 x 1 = 5)

1	**Discuss** role of different cell organelles in eukaryotic cells.	**U**	**CO1**
2	**Compare** between Prokaryotic and eukaryotic cells.	**U**	**CO1**
3	**What** are theconsequences of physiological disorders?	**R**	**CO4**
4	If someone is suffering from cancer, **what treatment can be given to treat the cancerous cells?**	**Ap**	**CO3**
5	**Which** of the following cell organelles is called the powerhouse of the cell? (a) Nucleus (b) Lysosomes (c) Chloroplast (d) Mitochondria	**UN**	**CO1**
	Group B **Answer All the Questions (5 x 2 = 10)**		
6 a)	Differentiate prokaryotic and Eukaryotic cell. What are mitochondria and explain its function.	**Ap**	**CO1**
	(OR)		
6 b)	What is the function and working principle of centrifuge.	**Evaluate**	**CO3**
7 a)	Define active and passive transport with examples. Differentiate between diffusion and osmosis.	**Ap**	**CO4**
	(OR)		
7 b)	Explain the causes of destruction of neurons in the brain?	**U**	**CO5**
8 a)	Describe the general steps involved in synaptic transmission	**R**	**CO3**
	(OR)		
8 b)	Discuss Advance level listening exercise	**U**	**CO3**

9 a)	Presentation of small skits.	**R**	**CO4**
	(OR)		
9 b)	**What** is Michaelis-Menten equation? Explain the significance of Km and Vmax enzyme from the above equation.	**Ap**	**CO3**
10 a)	**Differentiate** between competitive and uncompetitive inhibition of enzyme substrate reaction.	**R**	**CO4**
	(OR)		
10 b)	**Compare** between Prokaryotic and eukaryotic cells.	**R**	**CO4**
	Group C **Answer All the Questions (7 x 5 = 35)**		
11 a)	a) **What** are the factors influencing living cells and negative as well as positive ways?	**U**	**CO2**
	(OR)		
11 b)	What is Michaelis-Menten equation? Explain the significance of Km and Vmax enzyme from the above equation.	**R**	**CO4**
12 a)	Explain the mechanism for digestion of protein in gastrointestinal tract of human.	**U**	**CO1**
	(OR)		
12 b)	a) **What** is cell? b) **How** plant cells are different from animal cells? **Explain** any two cell organelles which are considered to be evolved by bacterial cells.	**U** **U**	**CO1**
13 a)	Write a report based on final year project details.	**R**	**CO4**
	(OR)		
13 b)	Write a suitable CV while you are applying for a suitable job.	**R**	**CO4**
14 a)	Define active and passive transport with examples. Differentiate between diffusion and osmosis.	**U**	**CO1**
	(OR)		
14 b)	**Discuss** role of different cell organelles in eukaryotic cells	**U**	**CO2**
15 a)	**Compare** between Prokaryotic and eukaryotic cells	**Evaluate**	**CO2**
	(OR)		
15 b)	If someone is suffering from cancer, **what treatment can be given to treat the cancerous cells?**	**U**	**CO2**
16 a)	**Explain** oncogenes. **How** can they affect the cells**? Is this relates with** Tumor suppressive gene? Discuss in detail.	**U**	**CO3**
	(OR)		
16 b)	**Explain** different type of networks in human body.	**U**	**CO3**
17 a)	**What** are the factors influencing living cells and negative as well as positive ways?	**Evaluate**	**CO-4**
	(OR)		

17 b)	**Explain**different techniques of medical biotechnology on human body to analyze the malfunction of different human system during diseased conditions.	**U**	**CO-5**

PHY12202	**Applied Science Lab**	L	T	P	C
Version 1.0	**Contact Hours - 30**	0	0	2	2
Pre-requisites/Exposure	Basics of knowledge of higher secondary level physics & Chemistry				
Co-requisites					

Course Objectives

1. To understand the experiments on general properties of matter.
2. To apply the knowledge of physical optics in different practical experiments.
3. To analyse different experiments on electrical and electronic science.
4. To explore different experiments related to fundamental knowledge on quantum mechanics.
5. To impart a scientific approach and to familiarize the applications of chemistry in the field of technology
6. An ability to gain knowledge about different types of qualitative and quantitative estimation

Course Outcomes

On completion of this course, the students will be able to

CO1: **Illustrate** about the elastic and other general properties of matter and their measurements.
CO2: **Acquire** the knowledge of physical optics and experimental techniques to verify them.
CO3: **Develop** the basic concepts related to electrical circuits.
CO4: **Find** the fundamental knowledge of basic quantum mechanics and few experiments related to it.
CO5: **Acquire** the basic information about semiconductor material and devices.
CO6: **Develop** the qualitative idea of thermo-electric currents and technique to measure it.

Catalog Description

Applied Science Labis used to apply existing scientific knowledge to develop more practical applications, for example: technology or inventions. In applied Science Labdifferent aspects of basic andmodern physics has been explored. Applied Science Labis generally developing technology, although there might be dialogue between basic science and applied science (research and development). In this course the focus will be on improving the logical learning moved into a physical environment.

Chemistry lab is a place where laboratory sessions is to enable the learners/students to get hands-on experience on the principles discussed in theory sessions and to understand the applications of these concepts in engineering. The course also includes theory on sampling, analyses of real samples, risk

assessment of chemical experiments, important steps and procedures in analytical chemistry, and evaluation/interpretation of results.

Course Content

Experiments: Physics

1. Determination of Young's Modulus of a Beam by traveling microscope by FLEXURE method.
2. Carry Foster's Method to Determine Resistance of a Given Coil.
3. Determination of the Coefficient of viscosity of water by Poiseulle's Capillary Flow method.
4. To determine the wavelength of sodium light by forming Newton's Ring.
5. Determination of Rigidity Modulus by dynamical method.
6. Determine the Plank's constant using photocell.
7. To verify Stefan's law by electrical method.
8. To study the temperature dependence of reverse saturation current in a junction diode and hence to determine the Band gap.
9. Determination of specific charge(e/m) of electron by J.J. Thomson's method.
10. Determination of the Rydberg constant by studying hydrogen or helium spectrum.
11. Determination of dielectric constant of a given dielectric material.
12. Determination of Hall coefficient of Semiconductor.
13. Study current – voltage characteristic load response of photovoltaic solar cells.

Experiments: Chemistry (Any Four)

1. Determination of total hardness of water by complexometric titration method
2. Determination of carbonate and bicarbonate in water
3. Estimation of iron (ferrous ion in Mohr salt) by permanganometry.
4. Determination of strength of an unknown HCl solution with standardized NaOH solution by conductometric titration.
5. Dissolved oxygen by Winkler's method

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

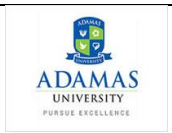
Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Name:		Applied Science Lab					Course Code:		PHY12202						
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	0	0	0	0	0	0	0	0	0	1	0	0	0
CO2	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0
CO3	3	3	0	0	0	0	0	0	0	0	0	1	0	0	0
CO4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO5	3	2	0	0	0	0	0	0	0	0	0	1	0	0	0
CO6	3	2	0	0	0	0	0	0	0	0	0	1	0	0	0
Average	3	2	0	0	0	0	0	0	0	0	0	1	0	0	0

1=weakly mapped
2=moderately mapped
3=strongly mapped

Name: **Enrolment No:**	

Course: PHY12202 –Applied Science Lab

Program: B.Tech. **Semester: ODD 2020-21**

Time: 03 hrs. **Max. Marks: 50**

SAMPLE QUESTIONS

1.	**Determine** Young's Modulus of a Beam by traveling microscope by FLEXURE method	**Ap**	**CO1**
2.	Carry Foster's Method to **Determine** Resistance of a Given Coil.	**Ap**	**CO1**
3.	**Determine** the Coefficient of viscosity of water by Poiseulle's Capillary Flow method.	**Ap**	**CO1**
4.	**Determine** the wavelength of sodium light by forming Newton's Ring.	**U**	**CO2**
5.	**Determine** Rigidity Modulus by dynamical method.	**Ap**	**CO1**

6.	**Determine** the Plank's constant using photocell.	**U**	**CO2**
7.	**Show** Stefan's law by electrical method.	**Ap**	**CO3**
8.	**Show** the temperature dependence of reverse saturation current in a junction diode and hence to **determine** the Band gap.	**U**	**CO4**
9.	**Determine** specific charge(e/m) of electron by J.J. Thomson's method.	**Ap**	**CO5**
10.	**Determine** the Rydberg constant by studying hydrogen or helium spectrum.	**Ap**	**CO6**
11.	**Determine** dielectric constant of a given dielectric material.	**U**	**CO5**
12.	**Determine** Hall coefficient of Semiconductor.	**U**	**CO5**
13.	**Show** current – voltage characteristic load response of photovoltaic solar cells.	**U**	**CO6**
14.	Experiments: Chemistry (Any Four) 1. **Determine** total hardness of water by complexometric titration method 2. **Determine** carbonate and bicarbonate in water 3. **Estimate** iron (ferrous ion in Mohr salt) by permanganometry. 4. **Determine** strength of an unknown HCl solution with standardized NaOH solution by conductometric titration. 5. Dissolve oxygen by Winkler's method	**Ap** **U** **Ap** **U** **Ap**	**CO7, CO8, CO9**

Model Question Paper

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING AND TECHNOLOGY
END-SEMESTER EXAMINATION: JULY 2020

Name of the Program: B.Tech Semester: I

PAPER TITLE: COMMUNICATION AND COLLABORATION SKILL-I

PAPER CODE: ENG11043
Maximum Marks: 50 Time duration: 3 hours
Total No of questions: 12 Total No of Pages: 01

Instruction for the Candidate:

1. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
2. All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

	Section A		
1.	Q1. You have given daily broadcasts in front of the class in magazine module. **What** do you think are the skills that you have developed in this process? (5) Q2.**What** was your approach towards negative criticism/feedback? (5) Q3. **What** is your contribution in this magazine? Please justify your role in regards to your contribution. (5) Q4. **What** is the theme of your magazine? What inspired you to select this theme? (5) Point out the parts of speech of the underlined words. (10) 1. These books _____ (belong/belongs) to me. 2. She _____ (want/wants) to go. 3. We _____ (will like/would like) to visit the museum. 4. He _____ (has finished/have finished) talking. 5. My brother _____ (enjoy/enjoys) playing cricket.	**U**	**CO3**
	SECTION B (Attempt any **One Question)**		
4.	Q1. **Compose** a letter giving an application of 100-200 words for the post of an account's assistant. 120 – 150 words) (20) Q2. **Compose** a letter giving an application of 100-200 words for the post of management trainee in Finance. (20)	**U**	**CO3**

DGS11001	**Design Thinking**	L	T	P	C

Version 1.0	**Contact Hours – 30**	2	0	0	2
Pre-requisites/Exposure	Knowledge of analyzing society problems and product usage problems and a zeal to improve the current situation, in addition to knowing to using laptop/computers, internet, social media interaction, file sharing and uploading, email and communication etiquettes.				
Co-requisites	-				

Course Objectives

1. To enable students to acquire knowledge, imagination and be more assertive on opinions on problems in society.
2. To enable students to learn basics of research, data collection, analysis, brainstorming to find solutions to issues.
3. To make them understand Design Thinking methodologies to problems in field of study and other areas as well.
4. To help students to understand future Engineering positions with scope of understanding dynamics of working between inter departments of a typical OEM.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand What Is Design Thinking?
CO2. Understand the Design Thinking Model and various stages of the same.
CO3. Understanding stages of Discovery, Defining a real time problem through primary and secondary research and discovery canvas.
CO4. Attempting to find solutions through concept development and simple prototyping.
CO5. Testing the developed prototype and iterating to perfect out the solutions for chosen problem.
CO6. Apply Design Thinking for solving real-world challenges

Catalog Description

Design thinking course is a completely online course offered to the first year UG programs across all streams. This course is designed to help understand the steps followed in the process of designing a solution to a problem.

Course Content

Unit I: 2 Lecture Hours

WHAT IS DESIGN THINKING: Designers seek to transform problems into opportunities. Through collaboration, teamwork, and creativity, they investigate user needs and desires on the way to

developing human-centered products and/or services. This approach is at the very heart of design thinking.

Unit II: **2 Lecture Hours**

THE DESIGN THINKING MODEL: A tool that helps guide you along a design thinking path. The model does this by providing a series of activities that that will help you effectively design a product, service or solution to a user's need. The model presents the approach as a process, allowing us to look at each step – or phase – along the journey to the development of a final design.

Unit III: **4 Lecture Hours**

PHASE 1: DISCOVER: Begin the design thinking process with the Discover phase, where you will identify the specific problem your design is intended to solve, as well as important usability aspects from those who will use your design. Discovery can be performed through a variety of different research methods which you will learn in this module.

Unit IV: **4 Lecture Hours**

PHASE 2: DEFINE: In the Define phase, you come to understand the problem. We often refer to this as framing the problem. You can do this by using a variety of tools, including storytelling, storyboarding, customer journey maps, personas, scenarios, and more.

Unit V: **4 Lecture Hours**

PHASE 3: DEVELOP: Turn your attention to solving the problem. In this phase you brainstorm custom creative solutions to the problems previously identified and framed. To do this, you conceptualize in any way that helps, putting ideas on paper, on a computer, or anywhere whereby they can be considered and discussed.

Unit VI: **4 Lecture Hours**

PHASE 4: DELIVER: This phase is all about testing and building concepts. Here you take all of the ideas that have been discussed to this point and bring them a little closer to reality by building a concept; something that makes it easier for a user to experience a design. This concept is referred to as a prototype.

Unit VII: **4 Lecture Hours**

PHASE 5: ITERATE: You will test the prototype of your design solution, collecting and acting on feedback received. These actions may mean minor or major revisions to your design, and are repeated as often as necessary until a solution is reached. Tools such as focus groups and questionnaires are used to help you collect feedback that can help with your final design.

Unit VIII: **2 Lecture Hours**

BEYOND DESIGN THINKING: The Design Thinking Model is a tool that helps guide you along a design thinking path. The model does this by providing a series of activities that that will help you effectively design a product, service or solution to a user's need. The model presents the approach as a process, allowing us to look at each step – or phase – along the journey to the development of a final design.

Reference Books

1. Brown, Tim. “What We Can Learn from Barn Raisers.” Design Thinking: Thoughts by Tim Brown. Design Thinking, 16 January 2015. Web. 9 July 2015.
2. Knapp, Jake. “The 8 Steps to Creating a Great Storyboard.” Co.Design. Fast Company & Inc., 21 Dec. 2013. Web. 9 July 2015.
3. van der Lelie, Corrie. “The Value of Storyboards in the Product Design Process.” Journal of Personal and Ubiquitous Computing 10.203 (2006): 159–162. Web. 9 July 2015. [PDF].
4. Millenson, Alisson. “Design Research 101: Prototyping Your Service with a Storyboard.” Peer Insight. Peer Insight, 31 May 2013. Web. 9 July 2015.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Name:		Design Thinking & Prototyping						Course Code:		DGS11002					
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	2	2	2	1	1	0	1	1	1	3	0	0	0
CO2	0	0	2	2	2	2	1	0	1	1	1	3	0	0	0
CO3	1	1	3	2	2	1	3	1	2	2	3	3	0	0	0
CO4	0	0	3	3	3	3	3	1	2	2	2	3	0	0	0
CO5	1	0	2	1	1	2	1	1	1	1	1	2	0	0	0
CO6	0	0	0	2	1	3	0	2	2	0	2	1	0	0	0
Average	0	0	2	2	2	1	1	0	1	1	1	3	0	0	0

1=weakly mapped
2= moderately mapped
3=strongly mapped

Model Question Paper

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING AND TECHNOLOGY
END-SEMESTER EXAMINATION: JULY 2020

Name of the Program: B. Tech Semester: I Stream: ECE

PAPER TITLE: Design Thinking
PAPER CODE: DGS11001
Maximum Marks: 50 Time duration: 3 hours
Total No of questions: 12 Total No of Pages: 01

Instruction for the Candidate:

- At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
- All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
- Assumptions made if any, should be stated clearly at the beginning of your answer.

	Section A (Answer All the Questions) (5 x 1 = 5)		
1.	**List** the steps involved in Design Thinking.	**U**	**CO1**
2.	**Estimate** the basic elements of Design Thinking.	**U**	**CO2**
3.	**Define** Napkin Pitch.	**R**	**CO3**
4.	**What** is Assumption testing?	**R**	**CO4**
5.	**Define** the principles of Ethnography.	**U**	**CO2**
	SECTION B (Attempt any **Three Questions) (3 x 5 = 15)**		
4.	Briefly **explain** the importance of ethnography in design thinking?	**U**	**CO2**
5.	**What** are the successive steps for concept development?	**Ap**	**CO3**
6.	**Explain** the different types of concept development strategies.	**Ap**	**CO3**
7.	**Explain**with Example: surface keys for Assumption Testing.	**Evaluate**	**CO4**
	SECTION C (Answer Any Two Questions) (2 x 15 = 30)		
8.	**Explain** in detail about importance of prototyping in Design Thinking.	**U**	**CO4**
9.	**Name** an importance of involving stakeholders in developing new concepts and Plan for conducting experiments within short time and inexpensively.	**Create**	**CO3**
10.	**Distinguish** between design thinking and visualization of a problem.	**An**	**CO1**

CSE12002	**Programming Lab**	L	T	P	C
Version 1.0	**Contact Hours – 45**	0	0	3	2
Pre-requisites/Exposure	10+2 Level Mathematics, Knowledge of Basics of Computer				
Co-requisites	Knowledge of Logical Reasoning and Analysis				

Course Objectives

1. To comprehend the practical nature of programming by solving through computer systems.
2. To practice the programming construct to solve multi-dimensional problems.
3. To relate and implement mathematical concepts through programming in order to solve computational problems.
4. To enable students to acquire structure and written expression required for their profession.
5. To understand the principles of data storage and manipulation.

Course Outcomes

On completion of this course, the students will be able to

1. **List and memorize various Unix commands. Also, students be able to construct various basic programs and appraise them.**
2. **Design and execute iterative statement in a program. Also, students be able to differentiate among different iterative structure.**
3. **Construct such programs that used to define user defined functions and to design library functions.**
4. **Implement array concept in 1-Dimensional and 2-Dimensional construct. Hence be able to design string functions to cater to various character array related problem.**
5. **Implement the concept of Stack, Queue, and Linked List and appraise them in different cases.**
6. **Simulate real life problems**

Catalog Description

Practical Programming skills are mandatory for designing or solving problems through digital device by implementation. To develop any software the behavior of a programming language is a must through problem solving. In present era almost all aspect of life is somehow largely related to virtualization and digital data/information. Devices from smartphones to other handheld devices, drones, cameras, medical instruments etc. all needs programming at some part. In engineering it has become quintessential for the students/research scholars to learn programming. In this course, students will learn how to solve problems in various domains through a programming language. This course enables students with the basic skills of C Programming Language. Five Different related modules comprise this course. First Unit familiarizes students with basics of computers, algorithmic method to solve problem, introduction to generic programming construct. Basics of C Programming is upto iterative structure is depicted in Unit II. In Unit III students will learn about modularization using functions and one advance concept of C Programming, Pointers. Unit IV will cover one of the most important concepts in C Programming, Array and Strings. Unit V will accomplish this course with the advance concept like Structure, Union and File Handling. After this course students will grow their analytical ability to solve problem and logical skill. Also, this course effectively creates the ability to grasp any other Programming Language in easier manner. In all these modules related programming problems are practiced to understand the syntactical and semantical correctness of a program. Gradually students become more comprehensive through the progress of the course.

Course Content

Experiments:

1. Familiarization with LINUX commands and vi editor.
2. Programs to demonstrate Decision Making, Branching and Looping, Use of break and continue statement etc.
3. Implementation involving the use of Arrays with subscript, String operations and pointers.
4. Implementation involving the use Functions and Recursion.
5. Implementation involving the use Structures and Files.
6. Implementation based on Stack Queues and Linked List for example Insertion and Deletion.

Text Books

1. Balagurusamy, E., n.d. Programming In ANSI C. 5th ed. Bangalore: McGraw-hill.
2. Gotfreid (196) *Schaum's Outline of Programming with C*, 2nd ed., USA: McGraw-Hill
3. Brian W. Kernighan, Dennis Ritchie (1988) *C Programming Language*, 2nd ed., : Prentice Hall.
4. Das Sumitabha, UNIX Concepts and Applications, 4th Ed., New Delhi, Tata McGraw-Hill

Reference Books

1. Al Kelley, Ira Pohl (1988) *A Book on C*, 4th ed. Addision Wesley Longman

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Name:		Programming Lab					Course Code:		CSE12002						
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	2	1	0	3	0	0	1	0	0	0
CO2	2	2	2	3	1	1	3	0	3	0	0	1	0	0	0
CO3	3	1	3	2	1	1	3	0	1	0	0	1	0	0	0
CO4	3	3	2	2	1	3	3	0	2	0	0	3	0	0	0
CO5	3	2	1	1	2	2	1	0	2	0	2	2	0	0	0
CO6	3	2	1	1	2	2	1	0	2	0	2	2	0	0	0
Average	3	2	1	1	2	2	1	0	2	0	2	2	0	0	0

1=weakly mapped
2= moderately mapped
3=strongly mapped

Model Question Paper

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING AND TECHNOLOGY
END-SEMESTER EXAMINATION: JULY 2020

Name of the Program: B. Tech Semester: I Stream: ECE
PAPER TITLE: PROGRAMMING LAB PAPER CODE: CSE12002
Maximum Marks: 50 Time duration: 3 hours
Total No of questions: 12 Total No of Pages: 01

Instruction for the Candidate:

1. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
2. All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

	Section A (attempt any two)		
1.	**What** do you understand data types?	**U**	**CO1**
2.	Define array?	**R**	**CO4**
3.	**How** user defined function reduces the no. of lines in a large program?	**R**	**CO2**
4.	**Why** pointer is advantageous than array?	**R**	**CO5**
5.	**What** is the size of an integer variable?	**R**	**CO1**
	SECTION B (Attempt any **Two Questions)**		
6.	**What** is dimension of an array. How many types of array are there? Can you store integer values and float type values in a single array, if not why? What you need to do to store such different types of values in an single array?	**R**	**CO4**
7.	**Design** an user defined function in c that would return multiple values in main() function.	**Ap**	**CO3**
8.	Suppose a paragraph is stored in a 2-D character array. **Find** a specific sentence in that paragraph using a c program.	**U**	**CO2/ CO4**
9.	State the types of data types and memory occupies. **What** are the ways to convert from one data type to another data type with suitable example	**U**	**CO1**
	SECTION C is Compulsory		
10.	**How** is it possible to take input in a 2-D array using a single for loop? Make it possible using a suitable program in c.	**Ap**	**CO4**
11.	**Design** a program in c to determine that a text is written in English or in any other language. If the text is written in any other language convert every character in its nearest English alphabets.	**U**	**CO4**

12	**Design** a program to create a pointer to an integer. Allocate memories for 50 elements into that pointer using both malloc() and calloc() function. Display the significance difference of using those two functions to allocate memory. Also state the specific needs of these two functions.	**U**	**CO4**

CEE12001	Engineering Drawing & CAD	L	T	P	C
Version1.0		0	0	4	2
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. To comprehend general projection theory, with an emphasis on the use of orthographic projection to represent three-dimensional objects in two-dimensional views.
2. To understand the application of industry standards and techniques applied in engineering drawing.
3. To apply auxiliary or sectional views to most practically represent engineered parts.
4. To Dimension and explain two-dimensional engineering drawings.
5. To employ freehand 3D pictorial sketching to aid in the visualization process and to efficiently communicate ideas graphically.

Course Outcomes

On completion of this course, the students will be able to

CO1. Identify the principle and significance of engineering drawing along with all the possible geometrical shapes.

CO2. Infer the principle and concept of projection of Points, Lines and Planes over Auxiliary Planes.

CO3. Demonstrate the principle and concept of Projection of Regular Solids.

CO4. Illustrate Sections and Sectional Views of Right Angular Solids and Regular Solids.

CO5. Interpret Isometric projection.

CO6. Analyze complex civil engineering problems, identify key issues, and develop effective solutions.

Catalog Description

In this fundamental course, students will be introduced to the basics of engineering drawing. Terms and definitions used in industries, such as manufacturing and construction, may also be covered. Specific skills introduced in this course may include sketching, geometric construction, auxiliary drawing, computing dimensions and lettering. Students will be also introduced to computer-aided drawing (CAD) software or techniques.

Course Content

Module 1 **Contact Hr. 9**

Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only);

Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module 2 **Contact Hr. 9**

Orthographic Projections covering, Principles of Orthographic Projections Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes.

Module 3 **Contact Hr. 8**

Projections of Regular Solids covering, those inclined to both the Planes- Auxiliary Views.

Module 4 **Contact Hr. 9**

Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.

Module 5 **Contact Hr. 10**

Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions

Reference Books

1. Engineering Drawing, N. D. Bhat, Charotar Publishing House (2012).
2. Shah, M.B. & B.C. Rana (2008), Engineering Drawing and Computer Graphics, Pearson Education.
3. Engineering Drawing & Graphics using Autocad, T. Jeyapoovan, Vikas Publishing House Pvt. Ltd.-Noida; Third edition (2010).
4. https://nptel.ac.in/courses/112103019/

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Name:		Engineering Drawing & CAD					Course Code:		CEE12001						
CO/PO	PO 1	PO2	PO3	PO4	PO5	PO 6	PO7	PO8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3

CO1	0	3	3	1	2	0	0	0	0	0	0	2	3	0	0
CO2	3	3	0	0	0	0	0	0	0	0	0	0	0	1	0
CO3	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0
CO4	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0
CO5	3	0	3	0	0	0	0	0	0	0	0	2	0	0	0
CO6	3	0	3	0	0	0	0	0	0	0	0	2	0	0	0
Average	2.0	1.5	2.0	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	0.2	0.0

1=weakly mapped 2= moderately mapped 3=strongly mapped

Model Question Paper

ADAMAS UNIVERSITY PURSUE EXCELLENCE	**ADAMAS UNIVERSITY** **END SEMESTER EXAMINATION** (Academic Session: 2020 – 21)		
Name of the Program:	B.Tech in CE	**Semester:**	I & II
Paper Title:	Engineering Drawing & CAD	**Paper Code:**	CEE12001
Maximum Marks:	50	**Time Duration:**	3Hrs
Total No. of Questions:	10	**Total No of Pages:**	1
(Any other information for the student may be mentioned here)	**13.** At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam. **14.** All parts of a Question should be answered consecutively. Each Answer should start from a fresh page. **15.** Assumptions made if any, should be stated clearly at the beginning of your answer.		

Instructions to the Students: Attempt at least 1 Question from each CO.

	Follow the instruction given by Lab Instructor during the exam		
1	A water tank of size 27 m^3 was represented in the drawing by 216 cm^3 size. Construct a vernier scale for the same to measure up to 5 metre. Also show on it the distance of 3.75 m, 0.27 m and 0.04 m.	**CO1**	**U**
2	A rectangular plot of land measuring 2.56 hectors is represented on a map by a similar rectangle of 16 sq. cm. Calculate RF of the scale. Draw a diagonal scale to read single meter. Show a distance of 368 m on it. (1 hector = 10^4 sq. meter)o	**CO1**	**R**

3	A point R is on HP and 35 mm in front of VP. Another point M is on VP and below HP. The line joining their front views make an angle of 30 deg to the reference line, while the line joining their top views makes an angle of 45 deg with the reference line. Find the distance of the point Q from HP.	**CO2**	**U**
4	Two points A and B are on HP. The point A is 35 mm in front of VP, while B is 50 mm behind VP. The line joining their top views makes an angle of 40 deg with XY. Find the horizontal distance between the two projectors.	**CO2**	**App**
5	Draw the projections of a regular hexagon of 25 mm sides, having one of its side in the H.P. and inclined at 60º to the V.P. and its surface making an angle of 45º with the H.P.	**CO3**	**U & App**
6	A cone of 40 mm diameter and 50 mm axis is resting on one generator on HP, which makes 30 deg inclinations with VP. Draw its projections.	**CO3**	**U & App**
7	A cylinder 40 mm diameter and 50 mm axis is resting on one point of a base circle on VP while it's axis makes 45^0 with VP and FV of the axis 35^0 with HP. Draw projections.	**CO4**	**R**
8	A square pyramid 30 mm base side and 50 mm long axis is resting on it's apex on HP, such that it's one slant edge is vertical and a triangular face through it is perpendicular to VP. Draw its projections.	**CO4**	**U & App**
9	A pentagonal pyramid of base side- 30 mm, and axis length- 60 mm is resting on HP on its base with a side of base perpendicular to VP. Draw the isometric projections.	**CO5**	**U & App**
10	A frustum of cone base diameter-50 mm, top diameter- 25 mm and height- 50 mm is placed centrally on a cylindrical slab of diameter-100 mm and thickness-30 mm. HP on its base with a side of base perpendicular to VP. Draw the isometric projection of the combination.	**CO5**	**U & App**

MTH11502	**Engineering Mathematics-II**	L	T	P	C
Version 1.0	**Contact Hours - 60**	3	1	0	4
Pre-requisites/Exposure	12th level Mathematics & Engineering Mathematics-I				
Co-requisites	--				

Course Objectives

1. To help the student to understand the basic concepts of matrix theory with its uses in engineering science.
2. To give emphasis about concepts of Eigen vlue and Eigen vector, vector space and linear transformation and enable students to apply these topics for analysing engineering problems.
3. To help the student to understand the use of vector calculus in engineering.
4. To give the students a perspective to learn about functions of complex variables, pole, and residues and their importance in advanced study of engineering science.
5. To enable students to acquire the knowledge of different transformation techniques and their applications in engineering science.

Course Outcomes

On completion of this course, the students will be able to

CO1	Highlight the knowledge of matrix theory for finding solution of a related engineering problem
CO2	Express the Eigen value(s) and Eigen vector(s) of a matrix
CO3	Apply the concept of vector space and linear transformation between the vector spaces
CO4	Analyze the knowledge of vector calculus and apply it for solving related problems
CO5	Evaluate the concept of complex variable and its application
CO6	Compose transformation technique for solving differential equation or difference equation

Course Description

For any engineering program, Mathematics is the backbone. With a sound knowledge in fundamental mathematics, an engineering student can become a very skillful engineer. In this course, the focus will be on learning Mathematics in depth, which will motivate students to grow their thinking ability in different fields of engineering. Students will be able to apply this knowledge to tackle almost all kinds of problems in engineering and science successfully. Class participation is a fundamental aspect of this course. Students will be encouraged to actively take part in all group activities (Problem solving, presentation etc.).

Course Content

Unit I: Sequences and Series [15L]

Sequences and their limits, convergence of series, Convergence Test (comparison test, Ratio test, Root test), Absolute and conditional convergence, Alternating series, Power series
Periodic functions, Definition of Fourier series, Euler's formulae, Dirichlet conditions, Change of interval, Even and odd functions, half range Fourier Sine & Cosine series

Unit II: Complex Variables [15L]

Limit, continuity, differentiability and analyticity of complex functions, Cauchy-Riemann equations, derivatives of analytic functions, line integrals in complex plane, Cauchy's integral theorem, independence of path, existence of indefinite integral, Cauchy's integral formula, Taylor's series, Laurent's series, zeros and singularities, Residue theorem

Unit III: Ordinary Differential Equations [20L]

Formation of ODE, order and degree, First order ODE, Method of separation of variables, Exact and non-exact equations, linear and Bernoulli's form, second order differential equations with constant coefficients, Complementary functions and Particular Integral, D-operator, method of variation of parameters, general linear differential equations with constant coefficients, Cauchy-Euler's equations, Simultaneous differential equations

UnitIV: Vector Calculus [10L]

Ordinary Integrals of Vectors, Line, surface and volume integrals of Vector fields, Gauss' divergence theorem, Green's and Stokes Theorems and their applications

Text Book:

1. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House

Reference Book:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications
2. G. B. Thomas Jr., M. D. Weir, J. R. Hass, Thomas Calculus Early Transcendentals, 12th Edition
3. James Stewart, Calculus: Concepts and Contexts, 4th Edition, Cengage Learning

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	**50**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Name:		Engineering Mathematics-II						Course Code:		**MTH11502**					
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0
CO2	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0
CO3	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0
CO4	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0
CO5	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0
CO6	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0
Average	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

Model Question Paper

ADAMAS UNIVERSITY PURSUE EXCELLENCE	**ADAMAS UNIVERSITY** **END SEMESTER EXAMINATION** (Academic Session: 20__ – 20__)		
Name of the Program:	B.Tech	**Semester:**	II

Paper Title:	Engineering mathematics II	**Paper Code:**	MTH11502
Maximum Marks:	50	**Time Duration:**	3 Hrs
Total No. of Questions:	17	**Total No of Pages:**	

4. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
5. All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
6. Assumptions made if any, should be stated clearly at the beginning of your answer.

	Group A **Answer All the Questions (5 x 1 = 5)**		
1	For which value of p the series $\sum \frac{1}{n^p}$ converge?	**U**	**CO1**
2	Define periodic function with an example.	**U**	**CO1**
3	Define analytic function.	**Ap**	**CO2**
4	What is the order and degree of the differential equation $\left(\frac{d^3y}{dx^3}\right)^2 + 2\left(\frac{dy}{dx}\right)^4 + 3y = 0$?	**U**	**CO3**
5	State Stokes theorem.	**Ap**	**CO4**
	Group B **Answer All the Questions (5 x 2 = 10)**		
6 a)	**Test** the convergence of the following series: $\sum_{n=1}^{\infty} \frac{n!2^n}{n^n}$	**U**	**CO1**
	(OR)		
6 b)	Find the range for the values of x so that the following power series converge: $\sum_{n=0}^{\infty}(2x)^n$	**U**	**CO1**
7 a)	Find the Fourier sine transforms of $f(x) = 5e^{-3x} - 7e^{-4x}$.	**U**	**CO1**
	(OR)		
7 b)	Construct half-range Cosine series of a function $f(x)$ defined in an interval (0 , T)	**U**	**CO1**
8 a)	Find the singularity of the complex valued function $f(z) = \frac{e^z}{(z-2)^2}$ at $z = 2$.	**Ap**	**CO2**
	(OR)		
8 b)	Find the value of the integral $\oint_C \frac{z^2-z+1}{z-1}\, dz$ where C is the circle $\lvert z\rvert = \frac{1}{2}$.	**Ap**	**CO2**
9 a)	Eliminate A and B to find the differential equation from the equation $y = Ae^{2x} + Be^{-2x}$	**U**	**CO3**
	(OR)		
9 b)	Find the integrating factor of $(x + 2y^3)\frac{dx}{dx} = y$	**U**	**CO3**

10 a)	If $F = 3xy\hat{\imath} - y^2\hat{\jmath}$, find $\int F \cdot dR$, where C is the curve in the xy plane $y = 2x^2$ from $(0,0)$ to $(1,2)$.	**Ap**	**CO4**
	(OR)		
10 b)	Using Green's theorem, find $\int_C [(y - \sin x)dx + \cos x\, dy]$, where C is the plane triangle enclosed by the st. lines $y = 0, x = \frac{\pi}{2}$ and $y = \frac{2}{\pi}x$.	**Ap**	**CO4**
	Group C **Answer All the Questions (7 x 5 = 35)**		
11 a)	Examine the convergence of the following series, $\sum_{n=1}^{\infty} \frac{n+2}{2(n+1)^2}$	**U**	**CO1**
	(OR)		
11 b)	Examine the convergence of the following series, $\frac{1.2}{3} + \frac{2.3}{5} + \frac{3.4}{7} + \cdots$	**U**	**CO1**
12 a)	Find Fourier Series for $\|x\|$ in the interval $[-\pi, \pi]$.	**U**	**CO1**
	(OR)		
12 b)	Find half range sine series of $\pi x - x^2$ in $(0, \pi)$ upto first three terms.	**U**	**CO1**
13 a)	Show that the complex valued function $f(z) = \|z\|^2$ is analytic only at $z = 0$.	**Ap**	**CO2**
	(OR)		
13 b)	Show that the complex valued function $f(z) = \sqrt{\|xy\|}$ is not differentiable at $z = 0$ but the Cauchy-Riemann equation is satisfied there.	**Ap**	**CO2**
14 a)	Solve $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = e^{3x}$	**U**	**CO3**
	(OR)		
14 b)	Solve $x\frac{dy}{dx} + y = y^2 \log x$	**U**	**CO3**
15 a)	Verify Stoke's theorem for $F = (2x - y)\hat{i} - yz^2\hat{j} - y^2z\hat{k}$ over the upper half surface of $x^2 + y^2 + z^2 = 1$, bounded by its projection on the xy-plane.	**Ap**	**CO4**
	(OR)		
15 b)	Use the line integral to compute work done by the force $F = (2y + 3)\hat{i} + xz\,\hat{j} + (yz - x)\hat{k}$ when it moves a particle from the point $(0,0,0)$ to the point $(2,1,1)$ along the curve $x = 2t^2,\ y = t, z = t^3$	**Ap**	**CO4**
16 a)	Find the value of $\oint_C \frac{\sin\pi z^2 + \cos\pi z^2}{(z-1)(z-2)}\, dz$ where C is the circle $\|z\| = 3$ by Cauchy's integral formula.	**Ap**	**CO2**
	(OR)		
16 b)	Find the value of $\oint_C \frac{3z^2 + z}{z^2 - 1}\, dz$ where C is the circle $\|z - 1\| = 1$ by Cauchy's integral formula.	**Ap**	**CO2**
17 a)	Solve by method of variation of parameters: $\frac{d^2y}{dx^2} + 9y = \sec 3x$.	**U**	**CO3**

	(OR)		
17 b)	Check whether the following differential equation is exact and then solve it. $(x^3 + xy^4)dx + 2y^3dy = 0$	**U**	**CO3**

GEE11001	**Electrical and Electronics Technology**	L	T	P	C
Version 3.0	**Contact Hours - 24**	2	0	0	2
Pre-requisites/Exposure	Idea about basic mathematics				
Co-requisites	12th level Physics				

Course Objectives

1. To understand dc network theorems and apply these theorems to calculate the voltage, current, and power for a given circuit.
2. To explain the concept of active power, reactive power, power factor, quality factor, and steady-state sinusoids.
3. To familiarize with passive components, active components, and measuring instruments.
4. To familiarize the working of diodes, transistors, and integrated circuits.
5. To implement mini projects based on the concept of electronics circuit concepts.

Course Outcomes

On completion of this course, the students will be able to

CO 1 Remembering: C.O. 1: Recall the key concepts, principles, and theories related to DC circuit analysis, AC circuit analysis, semiconductors, and transistors (BJT & FET).

CO 2 Understanding: C.O. 2: Explain the theories and methodologies discussed in the course, including network analysis, phasor representation, diode circuits, and transistor configurations.

CO 3 Applying: C.O. 3: Apply the knowledge gained on active and passive electronic components to solve real-world problems related to design as well as analysis of electrical & electronics systems.

CO 4 Analyzing: C.O. 4: Critically analyze and evaluate the various approaches and perspectives presented in the course, such as network theorems and transistor operation.

CO 5 Evaluating: C.O.: 5Assess the strengths and weaknesses of different theories and methodologies in the context of electrical circuit analysis and design.

CO 6 Creating: C.O.: 6 Develop original ideas and insights based on the knowledge acquired during the course, such as proposing innovative circuit solutions or improving existing designs.

Catalog Description

Electrical and Electronics Engineering is an integrated branch of engineering. This course deals with the technical aspects of electricity, especially the design and application of circuitry and electronic equipment. It also includes the concept of power generation and distribution, communication, and machine control. This engineering branch focuses on the practical application of electricity. It also specializes in the design, construction, and uses of electrical systems in our lives. Electrical and electronics engineering is offered in various professional courses such as Diploma, B.Tech, B.E., and

M.Tech. E.E.E. (Electrical and Electronics Engineering) incorporates fundamental knowledge in core disciplines such as control systems, communications, signal processing, microprocessors, radio frequency design, electric machines, and power generation.

Course Content

Unit I: 6 lecture hours

D.C. Circuit Analysis and Network Theorems: Concept of network, Active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, source transformation, Kirchoff's Law, mesh analysis and nodal analysis, star-delta transformation, network theorems: Thevenin's theorem, Norton's theorem, maximum power transfer theorem.

Unit II: 6 lecture hours

Steady State Analysis of A.C. Circuits: Sinusoidal, average and effective value, form the peak factors, concept of phasor, phasor representation of sinusoidal voltage and current, analysis of series-parallel RLC circuits. Apparent, active and reactive powers, power factor, resonance in series and parallel circuits, bandwidth and quality factors, necessity and advantages of three phase system, star and delta connections, balanced supply and balanced load, line and phase voltage/current relation, three phase power measurements.

Unit III: 5 lecture hours

Basics of Semi-Conductors and PN Junction: Introduction; Carrier Concentrations- the Fermi Level; Drift and diffusion current; PN Junction Diode in Equilibrium Conditions; Depletion Region formation, PN Junction Diode in Forward Biased and Reverse Biased Condition; Breakdown in PN Junction Diodes.

Unit IV: 4 lecture hours

Bipolar Junction Transistors: Introduction, Types: NPN and PNP; Current Components; Early Effect; Different Configurations of a Transistor and its Characteristics.

Unit V: 4 lecture hours

Field Effect Transistors: Introduction to MOSFET, Characteristics of MOSFETs; Analysis of MOS structure; Calculation of threshold voltage; I-V characteristics of MOSFETs.

Text Books

1. Electronic Devices & Circuit Theory: Boyelstad&Nashelsky
2. Electronics Fundamental and application: D.Chattopadhyay and P C Rakshit
3. Electronic Principle: Albert PaulMalvino
4. Digital circuits and design by S Salivahanan and SArivazhagan
5. V. N. Mittal and A. Mittal, *Basic Electrical Engineering*, Tata McGraw-Hill Publishing Company Ltd,2006.

Reference Books

1. Electronic Circuits, Discrete and Integrated- Charles Belove and Donald L.Schilling
2. Principles of Electrical Engineering and Electronics-VK Mehta, Rohit Mehta, SChand and Company, New Delhi
3. Solid State Electronic Devices- Ben G. Streetman and Sanjay Kumar Banerjee, PHI.

4. Fundamental of Digital Circuits by Anand Kumar 2nd Eddition, PHI Learning Pal, Rajendra and Korlahalli, J.S. (2011) Essentials of Business Communication. Sultan Chand & Sons. ISBN: 9788180547294.
5. Theodore Wildi,*ElectricMachines, Drives and Power Systems*, Pearson,2005.
6. Vincent Del Toro, *Electrical Engineering Fundamentals*, 2nd Ed., Prentice Hall India Learning Pvt. Ltd.,1989.
7. J. Millman, C. Halkias and C. D. Parikh, *Millman's Integrated Electronics: Analog and Digital Circuits and Systems*, 2nd Ed., McGraw Hill Education,2017.
8. D.P.Leach,A.P.MalvinoandG.Saha,*DigitalPrinciplesandApplications*,8thEd.,McGraw Hill Education,2014.

Modes of Evaluation: Quiz/Assignment/ Written Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Course Name: Electrical and Electronics Technology Course Code: GEE11001

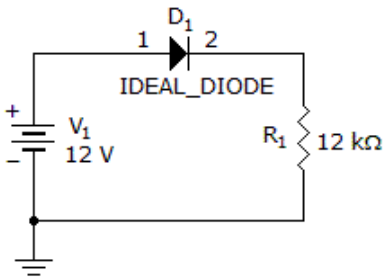
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	1	1	0	0	0	0	0	0	0	0
CO2	3	2	3	3	3	0	1	0	1	0	1	0	0	0	0
CO3	3	3	2	1	3	1	1	0	1	0	0	0	0	0	0
CO4	3	3	3	2	2	0	0	0	1	0	0	0	0	0	0
CO5	3	3	3	2	2	0	0	0	1	0	0	0	0	0	0
CO6	2	2	2	2	1	0	0	0	1	0	0	0	0	0	0
Average	2.8	2.7	2.5	1.8	2.2	0.3	0.5	0	0.8	0	0.2	0	0	0	0

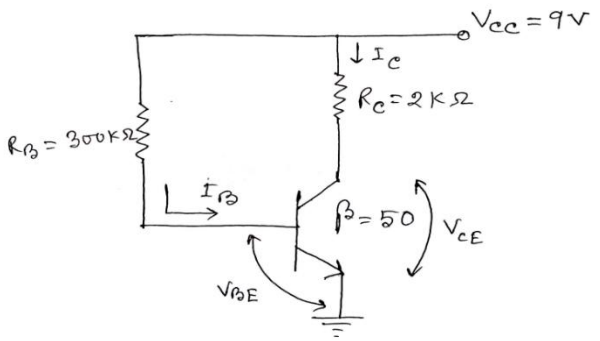
1=weakly mapped
2= moderately mapped
3=strongly mapped

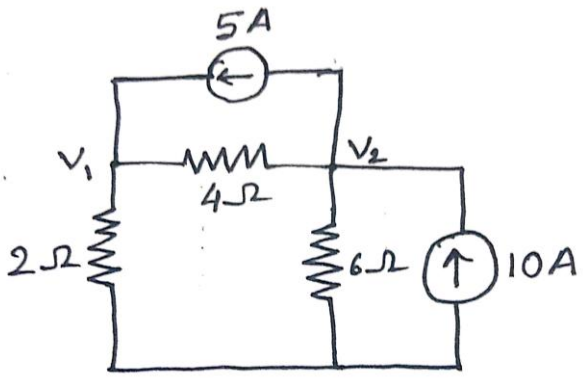
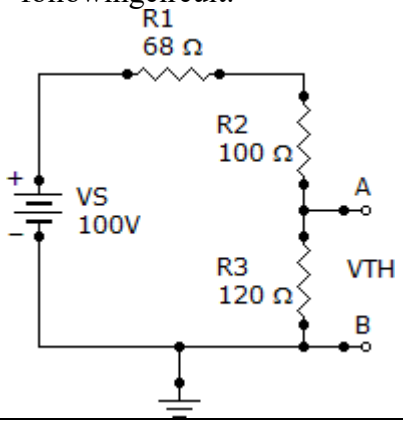
Model Question Paper

ADAMAS UNIVERSITY PURSUE EXCELLENCE	**ADAMAS UNIVERSITY** **END SEMESTER EXAMINATION** (Academic Session: 2020 – 21)		
Name of the Program:	B. TECH	**Semester:**	II

Paper Title:	Electrical & Electronics Technology	**Paper Code:**	GEE11001
Maximum Marks:	50	**Time Duration:**	3 Hrs
Total No. of Questions:	17	**Total No of Pages:**	03
(Any other information for the student may be mentioned here)	**7.** At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam. **8.** All parts of a Question should be answered consecutively. Each Answer should start from a fresh page. **9.** Assumptions made if any, should be stated clearly at the beginning of your answer.		

Group A **Answer All the Questions (5 x 1 = 5)**			
1	**What** is the current through the diode?  **a)** 1 mA **b)** 0.975 mA **c)** 0.942 mA **d)** 0.5 mA	**R**	**CO4**
2	The active region of a BJT the emitter junction is in .....bias and collector junction is in .....bias. **a)** Forward, Reverse **b)** Forward, Forward **c)** Reverse, Forward **d)** Reverse, Reverse	**R**	**CO5**
3	**Find** the decimal equivalent of hex number 1A53. **a)** 6793 **b)** 6739 **c)** 6973 **d)** 6379	**R**	**CO6**
4	Power factor of electric bulb is **a)** Unity **b)** Lagging **c)** Leading **d)** Zero	**R**	**CO3**
5	The active power drawn by a capacitor **a)** 0 **b)** 1 **c)** 0.5 **d)** 2	**R**	**CO1**
Group B **Answer All the Questions (5 x 2 = 10)**			
6 a)	**Why** does a pure semiconductor behave like an insulator at absolute zero temperature?	**R**	**CO4**
(OR)			
6 b)	**Define** the following: **a)** Power factor, **b)** Quality factor.	**R**	**CO3**
7 a)	In a BJT, the emitter current (I_E) is 12 mA. If I_E is 1.02 times of	**R**	**CO5**

	the collector current, then **find** the base current.		
	(OR)		
7 b)	Transform the sinusoid to phasor: V= -4 sin (30t -400).	**A**	**CO3**
8 a)	**Compare** between BJT & FET.	**U**	**CO5**
	(OR)		
8 b)	Define the following: i) Active Power. ii) Reactive Power.	**U**	**CO2**
9 a)	Convert numbers: **i)** $(53.625)_{10} = (?)_2$, **ii)** $(A3B)_{16} = (?)_{10}$	**R**	**CO6**
	(OR)		
9 b)	Draw the phasor diagram of R-L-C series circuit when XL>XC	**E**	**CO2**
10 a)	**Determine** the collector current (I_C) and V_{CE} for the given circuit as shown in figure. (Consider V_{BE}=0.7V for a Silicon Transistor) 	**E**	**CO5**
	(OR)		
10 b)	A single 50 Hz motor takes 100 A at 0.85 p.f lagging from a 240 V supply. Calculate the (i) active and reactive components of the current and (ii) the power taken from the supply.	**E**	**CO2**
	Group C **Answer All the Questions (7 x 5 = 35)**		
11 a)	**i) Explain** the phenomenon of diffusion of current carriers in a semiconductor. **ii)** Write Einstein's relation between mobility & diffusivity.	**U**	**CO4**
	(OR)		
11 b)	Find the node voltages V1 and V2 in the circuit	**A**	**CO1**

			
12 a)	**Analyze** the current components of PNP in Bipolar Junction Transistor.	**AN**	**CO5**
	(OR)		
12 b)	**Find** the Thevenin's equivalent circuit for the followingcircuit. 	**AN**	**CO1**
13 a)	**i)Design** and implement EX-OR gate using NAND gate. **ii)Determine** the hole concentration of a silicon crystal having donor concentration of $2.4*10^{24}$ /m^3, when intrinsic carrier concentration is $1.6*10^{18}$ /m^3? Find the ratio of electron and hole concentration.	**C, E**	**CO6 & CO4**
	(OR)		
13 b)	A certain current source has the values I= 4 μA and R = 1.2 MΩ. Determine the values for an equivalent voltage source.	**An**	**CO1**
14 a)	**i) What** is Fermi level? **Show** that the Fermi level is at the centre of forbidden gap in an intrinsic semiconductor. **ii) Determine** the current in a p-n junction, considering it at T=300 K, in which $I_S=10^{-14}$ Aandn = 1. Find the diode current for V_D = 0.7 v and V_D = - 0.7 v	**E**	**CO4**
	(OR)		
14 b)	What is resonance? Derive expression of resonance frequency for series R-L-C circuit.	**U**	**CO2**
15 a)	**i)** Draw schematically the structure of n channel JFET and explain the operation briefly.	**U, R**	**CO5, CO4**

	ii) Why Silicon type transistors are more often used than Germanium type?		
(OR)			
15 b)	Prove that the energy stored in the inductor is, W = 1/2 L i^2 (where, 'L' is the capacitance and 'i' is the current through inductor)	**E**	**CO2**
16 a)	**i)** How you measure resistance value using colour code and power rating of a resistor? **ii)**Briefly explain the three regions that are present in the drain characteristics of JFET?	**R, U**	**CO6**
(OR)			
16 b)	Write a short note on maximum power transfer theorem.	**R**	**CO1**
17 a)	**i)**What is Fermi level? Show that the Fermi level is at the centre of forbidden gap in an intrinsic semiconductor. **ii)**Why transistor is called current controlled device?	**R**	**CO5**
(OR)			
17 b)	Draw the phasor diagram of the following circuits. (i) Series RL circuit and (ii) Parallel RLC circuit	**U**	**CO3**

MEE11002	**Engineering Mechanics**	L	T	P	C
Version 1.0	**Contact Hours – 60**	3	1	0	4
Pre-requisites/Exposure	12th level Physics, Mathematics				
Co-requisites	--				

Course Objectives

1. To enable learners to solve force problems related to practical world.
2. To be able to determine the centroid, centre of gravity and moment of inertia.
3. To learn the effect of friction on equilibrium.
4. To learn kinematics, kinetics of particle and rigid body, related principles.
5. To introduce the concepts of Dynamic motion.

Course Outcomes

On completion of this course, the students will be able to

1. **Define conditions of equilibrium of bodies subjected to forces**
2. **Express the centroid, centre of gravity and moment of inertia of various one dimensional and two dimensional objects**
3. **Determine motion under the effect of dry friction**
4. **Explain the concept of virtual work for bodies in equilibrium**

5. **Review the D'Alembert's Principle for reducing the problem of kinetics to equivalent statics problem.**
6. **Solve the problems related to statics and dynamics**

Catalog Description

Engineering Mechanics. This is a basic first level course to learn rigid body mechanics covering both statics and dynamics. Statics covers free body diagrams, equilibrium of rigid bodies, analysis of trusses and beams, discussion on friction, virtual work and stability. Students will be expected to be familiar with engineering problems related to practical field.

Course Content

Module 1 **15 lecture hours**

Basics of Statics and Concurrent Forces

Statics of Particles: Force System: Force, classification & representation, force as a vector, composition and resolution of forces, principle of superposition and transmissibility of forces.

Statics of Rigid bodies: Equilibrium of coplanar force system, free body diagrams, determination of reactions, equilibrium of a body under three forces, Lami's theorem. Moment of a force about a point and an axis, moment of coplanar force system, Varignan's theorem.

Module 2: **15 lecture hours**

Parallel and Distributed Forces

Parallel forces in a plane, Distributed Parallel forces in a plane, couple, resolution of a force into a force and a couple, moment of a couple.

Centroid and Moment of Inertia: Determination of centre of gravity, centre of mass and centroid by direct integration and by the method of composite bodies, area moment of inertia of composite plane figures and mass moment of inertia, radius of gyration, parallel axis theorem, Pappas theorems, polar moment of inertia.

Module 3: **10 lecture hours**

FrictionIntroduction to wet and dry friction, laws of dry friction, cone of friction, block friction, ladder friction, wedge friction, application of friction in machines.

Module 4: **10 lecture hours**

Virtual Work Virtual displacement, principle of virtual work.

Module 5: **10 lecture hours**

Introduction to Dynamics Laws of motion, Projectile motion, D'Alembert's Principle, Work and energy, impulse and momentum, impact of bodies.

Text Books

1. Engineering Mechanics [Vol-I & II] by Meriam&Kraige, 5th ed. – Wiley India
2. Engineering Mechanics by S.S. Bhavikatti and K.G. Rajashekarappa – New Age International
3. Mechanics of Solids by Crandall,Dahl and Sivakumar-MC Graw Hill ,5th Edition 2015,New Delhi

Reference Books

1. Engineering Mechanics: Statics & Dynamics by I.H.Shames, 4th ed. – PHI
2. Engineering Mechanics by Timoshenko, Young and Rao, Revised 4th ed. – TMH

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs) and Program Specific Outcomes (PSOs)

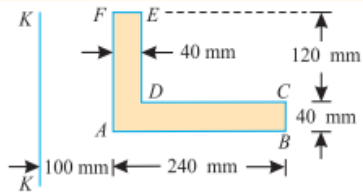
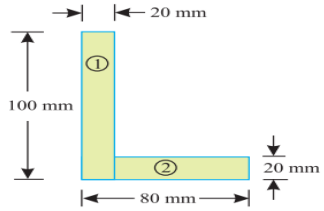
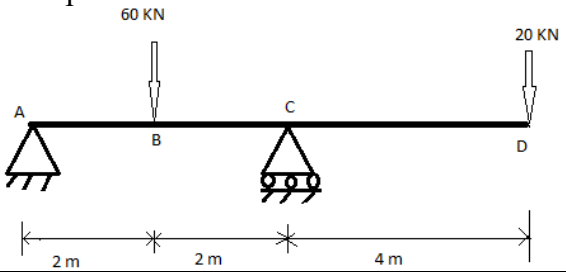
Course Name:		Engineering Mechanics						Course Code:		MEE11002					
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	2	0	0	0	1	1	1	1	0	1	0	1	0	3	0
CO2	2	0	0	0	1	1	1	1	0	1	0	1	0	3	0
CO3	2	0	3	0	1	1	1	1	0	1	0	1	0	3	0
CO4	0	3	3	2	1	1	1	1	0	1	0	1	0	3	0
CO5	0	0	3	2	1	1	1	1	0	1	0	1	0	3	0
CO6	0	0	3	2	1	1	1	1	0	1	0	1	0	3	0
Average	2	3	3	2	1	1	1	1	0	1	0	1	0	3	0

1=weakly mapped
2= moderately mapped
3=strongly mappe

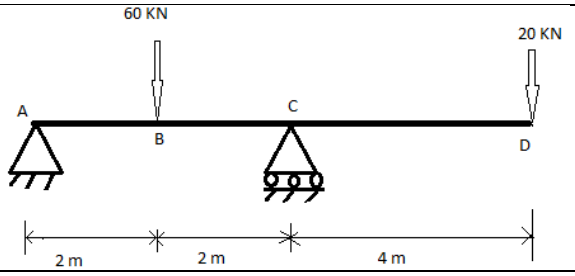
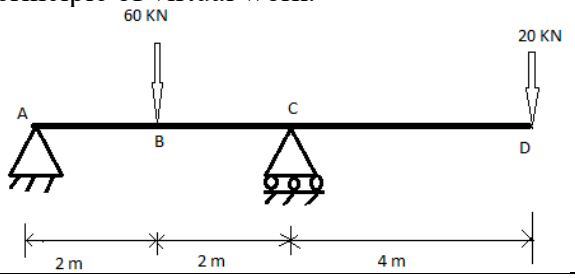
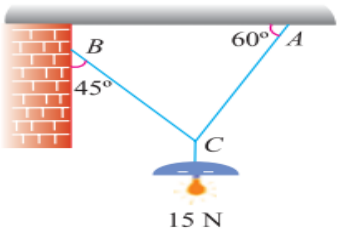
Model Question Paper

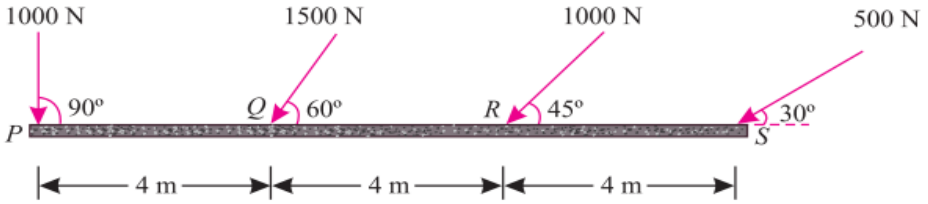
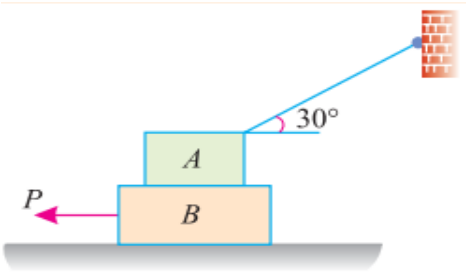
ADAMAS UNIVERSITY	**ADAMAS UNIVERSITY** **END SEMESTER EXAMINATION** (Academic Session: 2021 – 22)		
Name of the Program:	B. TECH	**Semester:**	II
Paper Title:	Engineering Mechanics	**Paper Code:**	MEE11002
Maximum Marks:	50	**Time Duration:**	3 Hrs

Total No. of Questions:	17	**Total No of Pages:**	03
(Any other information for the student may be mentioned here)	**10.** At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam. **11.** All parts of a Question should be answered consecutively. Each Answer should start from a fresh page. **12.** Assumptions made if any, should be stated clearly at the beginning of your answer.		

	Group A **Answer All the Questions (5 x 1 = 5)**		
1	**Explain**the Parallelogram Law of forces.	**U**	**CO1**
2	**Explain**: Varignon's principle of moments	**U**	**CO1**
3	 Compute the moment of inertia of the above area about axis K-K.	**R**	**CO2**
4	**Find** the centroid of an unequal angle section 100 mm × 80 mm × 20 mm. 	**R**	**CO2**
5	**What** is friction?	**U**	**CO3**
	Group B **Answer All the Questions (5 x 2 = 10)**		
6 a)	a) **Explain** principle of transmissibility? (b)**Find** out the reaction forces at support as shown in figure below using principle of virtual work. 	**U**	**CO1**
	(OR)		
6 b)	F1 and F2 are two collinear forces. When they act in opposite directions, their resultant is 34N, when they act at right angles to each other, their resultant is 50N. Find F1 and F2.	**R**	**CO3**

7 a)	Explain free body diagram with an example.	**R**	**CO5**
	(OR)		
7 b)	Define Radius of gyration, product of inertia and principal moment of inertia.	**A**	**CO3**
8 a)	State and prove Varignon's theorem.	**U**	**CO5**
	(OR)		
8 b)	What is instantaneous centre? How can it be located?	**U**	**CO2**
9 a)	Show that the acceleration at any instant during simple harmonic motion is directly proportional to the displacement from the mean position	**R**	**CO6**
	(OR)		
9 b)	An elevator weights 2500 N and is moving vertically downwards with constant acceleration. Write the equation for the elevator cable tension. Starting from rest it travels a distance of 35 metres during an interval of 10 seconds. Find the cable tension during this time. Neglect all other resistances to motion. What are the limits of cable?	**E**	**CO2**
10 a)	F1 and F2 are two collinear forces. When they act in opposite directions, their resultant is 34N, when they act at right angles to each other, their resultant is 50N. Find F1 and F2.	**E**	**CO5**
	(OR)		
10 b)	State D'Alemberts principle. Draw the free body diagram of a lift of weight 'W', moving upwards with an acceleration 'a' and also write the equations of dynamic equilibrium using this principle.	**E**	**CO2**
	Group C **Answer All the Questions (7 x 5 = 35)**		
11 a)	A body is moving with simple harmonic motion and has amplitude of 4.5 m and period of complete oscillation of 3.5s. Find the time required by the body in passing between two points which are at a distance of 3.5 m and 1.5 m from the centre and are on the same side.	**U**	**CO4**
	(OR)		
11 b)	A body of mass 50 kgs is suspended by two springs of stiffness 4kN/m and 6 kN/m. The body is pulled 50 mm down from its equilibrium position and then released. Calculate the frequency of oscillation, maximum velocity and (10) P 2000 N For More Visit : KtuQbank.com | Fair Use Policy 00000BE100121805 4 maximum acceleration if i) springs are connected in series ii) springs are connected in parallel.	**A**	**CO1**
12 a)	**Analyze** the current components of PNP in Bipolar Junction Transistor.	**AN**	**CO5**
	(OR)		
12 b)	For the system of forces, determine the magnitude, direction of the resultant force about A.	**AN**	**CO1**
13 a)	State Parallel axis Theorem.	**C, E**	**CO6 & CO4**
	(OR)		
13 b)	a) **Explain** principle of transmissibility? (b)**Find** out the reaction forces at support as shown in figure below using principle of virtual work.	**U**	**CO1**

			
14 a)	A 4m long ladder, 180N in weight, is supported against a wall (which is perpendicular to the floor) with its foot on the floor. The coefficient of friction between wall and the ladder is 0.2 and that between floor and ladder is 0.4.The ladder supports a weight of 900N at a distance of 1m along the ladder from its top. Compute the least value of the angle between the floor and the ladder for its equilibrium.	**E**	**CO4**
	(OR)		
14 b)	a) **Explain** principle of transmissibility? (b)**Find** out the reaction forces at support as shown in figure below using principle of virtual work. 	**U**	**CO1 /CO4**
15 a)	(a) **Explain** Laws of friction? (b) An effort of 200 N is required just to move a certain body up an inclined plane of angle 15° with the force acting parallel to the plane. If the angle of inclination of the plane is made 20° the effort required, again applied parallel to the plane, is found to be 230 N. **Find** the weight of the body and the coefficient of friction.	**Ap**	**CO3**
	(OR)		
15 b)	An electric light fixture weighting 15 N hangs from a point C, by two strings AC and BC. The string AC is inclined at 60° to the horizontal and BC at 45° to the horizontal as shown in Figure. Using Lami's theorem, **determine** the forces in the strings AC and BC. 	**U**	**CO1**
16 a)	A horizontal line PQRS is 12 m long, where PQ = QR = RS = 4 m. Forces of 1000 N, 1500 N, 1000 N and 500 N act at P, Q, R and S respectively with	**U**	**CO1**

	downward direction. The lines of action of these forces make angles of 90°, 60°, 45° and 30° respectively with PS. **Find** the magnitude, direction and position of the resultant force 		
(OR)			
16 b)	Determine the angle between the vectors A = 4i-3j+k and B=2i-6j-3k	**R**	**CO1**
17 a)	Two blocks A and B of weights 1 kN and 2 kN respectively are in equilibrium position as shown in Figure 1. If the coefficient  of friction between the two blocks as well as the block B and the floor is 0.3,**find** the force 'P' required to move the block.	**An**	**CO3**
(OR)			
17 b)	(a) **Explain** Laws of friction? (b) An effort of 200 N is required just to move a certain body up an inclined plane of angle 15° with the force acting parallel to the plane. If the angle of inclination of the plane is made 20° the effort required, again applied parallel to the plane, is found to be 230 N. **Find** the weight of the body and the coefficient of friction.	**Ap**	**CO3**

Course code: EVS11112	**Course Name: Environmental Science**	**L**	**T**	**P**	**C**
Version 1.1	**Contact Hours – 30**	2	0	0	2
Pre-requisites/Exposure	Basic physics, chemistry, mathematics of +2 level.				
Co-requisites	--				
Academic year	2022-23				

Course Objectives

5. To understand the intrinsic relation between humans and the environment, our position in the ecosystem around us
6. To comprehend the significance of the biodiversity surrounding us.

7. To figure out the importance and need for energy resources, various sources of energy, renewable and non-renewable sources, conventional and unconventional sources.
8. To have basic concepts about sustainability, our dependence on nature, and the consequences of overexploitation.
9. To enable students to appreciate the importance and how much we owe to the earth systems for our survival.
10. To have a basic concept about the types of pollution and mitigation procedures.
11. To have an overall idea about the environmental legal framework in our country and about the EIA and environmental audit procedures.

Course Outcomes: On completion of this course, the students will be able to

CO 1: Distinguish between various types of ecosystems, ecosystem dynamics, perceive and appreciate the surrounding nature.

CO 2: Feel connected with the intrinsic relation between humans and environment, our position in the ecosystem around us, and importance of biodiversity.

CO 3: Comprehend the presence of various pollutants, their significance, and impacts, and develop the underlying concepts involved in various air pollution prevention and mitigation measures.

CO 4: Understand the basic science which can explain the phenomena occurring around us.

CO 5: Build the in-depth knowledge about natural resources including energy resource.

CO 6: Understand the legal framework in our country for safeguarding the environment including pollution prevention, control, management, and wildlife management.

Catalog Description

To distinguish between various types of ecosystems, ecosystem dynamics, perceive and appreciate the surrounding nature and feel connected, develop the concept of the innate relationship of humans and biodiversity, need for conservation, and different conservation strategies. The students will be developed in a way so that they can spontaneously comprehend the importance of studying the various air pollutants, their significance, and impacts, and develop the underlying concepts involved in various air pollution prevention and mitigation measures, understand fundamental water chemistry, deduce the relationship between various water pollutants, and understand the principles of various water and wastewater treatment procedures. They will understand the routes of generation, classification, management, and environmental significance of solid waste, apply the basic concepts of waste management in their daily lives, understand the need of the 5Rs of waste management, the importance of waste minimization.

Detailed syllabus

Unit I: Resources

Multidisciplinary nature of environmental sciences; scope and importance; need for public awareness; concept of sustainability and sustainable development

Forest resources: Function of forests, cause and effects of deforestation, case studies.

Water resources: distribution of water, hydrological cycle, use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies
Food Resources: World food problems and environmental concern, Food security, case studies
Energy resources: Concept of energy, SI Units of Work, Heat and Power, World energy use, Energy consumption pattern in India and U.S., Environmental aspects of energy utilization Renewable and non-renewable sources; Fossil fuel: types, use and environmental impacts, Solar energy: Solar Radiation – Passive and active solar systems – Flat Plate and Concentrating Collectors – Solar direct Thermal Application– Fundamentals of Solar Photo Voltaic Conversion- advantages and disadvantages of Solar Power generation, Solar energy status in India; Wind Energy: site selection, Wind turbine: basic working principle and types, Wind energy status in India, advantages and disadvantages of Wind Power generation; Hydroelectric power : How is it generated, advantages and disadvantages; Biomass energy: various types, generations of biofuel, Biogas plants, Bio diesel; Geothermal Energy: source, advantages and disadvantages, Nuclear Power: nuclear fission, moderation of reaction, nuclear reactor: pressurized water reactor, advantages and disadvantages

Unit II: Ecosystems and Biodiversity and its conservation
Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Food chains, food webs and ecological pyramids, energy flow, ecological succession, Levels of Biodiversity: genetic, species and ecosystem diversity. Biogeographical classification of India, Values of biodiversity, Biodiversity at global, National and local levels, India as a mega-diversity nation, Biodiversity hotspots, Threats to Biodiversity, In-situ and Ex-situ conservation of Biodiversity

Unit III: Environmental Pollution and Waste Management
Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution, marine pollution; case studies. Nuclear hazards and human health risks.
Sources and generation of solid wastes, their characterization, chemical composition and classification. Different methods of disposal and management of solid wastes, Recycling of waste material. Waste minimization technologies.

Unit IV: Global Issues and Environmental Acts if India
Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, habitat loss, Holocene Extinction.
International agreements on Environmental conservation and pollution prevention.
Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and Control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. Waste Management Rules, 2016 and other important acts.

Text Books:

1. Principles of Environmental Science, 4th edition by Cunningham, W.P. and Cunningham, M.A. (2002), Tata McGraw-Hill Publishing Company, New Delhi

2. Basic Environmental Engineering & Elementary Biology by Monidranath Patra and Rahul Kumar Singha, Aryan Publishing house

3. Introduction to Environmental Engineering and Science, by Masters, G.M., Prentice Hall of India, Second Indian Reprint.

Reference Books:

1 Wastewater Engineering: Treatment and Reuse, 4th Edition, Metcalf and Eddy, Inc. McGraw-Hill, Inc., New York, 2002

2 Environmental Engineering", Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, McGraw-Hill Education (India) Private Limited, New Delhi

3 Introduction to Environmental Engineering, 2nd Ed. by Davis, M. L. and Cornwell D. A. McGraw Hill, Singapore.

4 Environmental Sciences: The Environment and Human Impact by Jackson, A.R.W. and Jackson, J.M., Longman Publishers

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Name:		Environmental Science						Course Code:		**EVS11112**					
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	2	2	0	0	2	0	0	0	0	0	0	0	0	0
CO2	2	0	3	0	0	3	1	0	0	0	0	0	0	0	0
CO3	0	3	-	0	0	1	3	0	0	0	1	0	0	0	0
CO4	1	0	1	0	0	1	3	0	0	0	0	0	0	0	0
CO5	2	0	3	0	0	3	1	0	0	0	0	0	0	0	0
CO6	1	0	1	0	0	1	3	0	0	0	0	0	0	0	0
Average	2	3	3	0	0	3	3	0	0	0	1	0	0	0	0

1=weakly mapped; 2= moderately mapped; 3=strongly mapped

Model Question Paper

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING AND TECHNOLOGY

Name of the Program: B.Tech Semester: II — Stream: ECE
PAPER TITLE: Environmental Science — PAPER CODE: EVS11107
Maximum Marks: 50 — Time duration: 3 hours
Total No of questions: 12 — Total No of Pages: 02

Instruction for the Candidate:

1. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date ofExam.
2. All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

	Section A (Answer All the Questions) (5 x 1 = 5)		
1.	Briefly **evaluate** what information about any ecosystem are conveyed by ecological pyramids?	**U**	**CO1**
2.	**Analyse** how DO of a water body is related to eutrophication?	**U**	**CO3**
3.	**What** are the diverse applications of solar energy unlike other renewable energy resources?	**R**	**CO4**
4.	**What** are the different types of wind turbine?	**R**	**CO4**
5.	Mention few problems associated with large dams.	**R**	**CO2**
	SECTION B (Attempt any **Three Questions) (3 x 5 = 15)**		
4.	**What** are the adverse effects of open dumping of municipal solid wastes on environment? **How** does sanitary landfill differ from open dumping? (2.5+2.5 = 5)	**U**	**CO5**
5.	**What** is electrostatic precipitator? **What** are the advantages of electrostatic precipitator? (2.5+2.5 = 5)	**U**	**CO3**
6.	**Describe** the distribution of water resources.	**R**	**CO5**

7.	**Estimate** a simple flowchart describing the steps that are followed in an EIA process in India.	**R**	**CO6**
	SECTION C (Answer Any Two Questions) (2 x 15 = 30)		
8.	**How** is photochemical smog formed? **What** are effects of photochemical smog? **Discuss** the factors affecting photochemical smog? (5+5+5=15)	**U**	**CO4**
9.	**What** do you mean by BOD of water? **How** thermal pollution of water is linked to DO? A city discharges 1.25 m^3/s of wastewater into a stream whose minimum rate of flow is 8.0 m^3/s. The velocity of the stream is about 3.0 km/h. The temperature of the wastewater is 20°C and that of the stream is 15°C. The 20°C BOD_5 of the wastewater is 250 mg/l and that of the stream is 2 mg/L. The wastewater contains no dissolved oxygen, but the stream is flowing with saturated DO concentration of 9.2 mg/L. Saturated DO at 15°C is 10.2 mg/L. At 20°C, deoxygenation constant (k^1) is estimated to be 0.3 per day and reaeration constant (k^2) is 0.7 per day. Determine the critical oxygen deficit and its location. Also estimate the 20°C BOD_5 of a sample taken at the critical point. Use the temperature coefficients of 1.135 for k^1 and 1.024 for k^2. (4+4+7=15)	**Ap**	**CO3**
10.	**What** is hazardous waste? Discuss the methods of hazardous waste management? What is composting? (4+7+4=15)	**U**	**CO3**

EIC11001	**Venture Ideation**	L	T	P	C
Version 2.0	**Contact Hours – 30**	2	0	0	2
Pre-requisites/Exposure	Basic knowledge of English and computer applications such as Internet Explorer and MS Office				
Co-requisites	--				

Course Objectives

1. To help the students understand the way to be an Entrepreneur
2. To identify the right business opportunity
3. To empower students to perform a technical feasibility study and thereby developing a prototype
4. To help students in identifying their customers using primary and secondary research methods.
5. Expose students to various factors of market and competition with the help of market feasibility study, forecasting techniques, business model canvass and insights about financial statements.
6. To prepare students with finalizing their entrepreneurial Portfolio

Course Outcomes

On completion of this course, the students will be able to:

CO1. Assess personal capacity in the context of the entrepreneurial process

CO2. Assess characteristics of successful entrepreneurs and entrepreneurial forms and processes

CO3. Apply resources, research and tools for Entrepreneurial ventures

CO4. Analyze and apply opportunity identification techniques, feasibility terminology, processes and models

CO5. Develop Ideation and planning documents for entrepreneurial venture
CO6. Create pitch presentation for business

Catalog Description

Over the last decade, the core of our economy has been transitioning from one of industrial might, large monolithic corporations and mass production towards one of networks, flexible enterprises comprising many smaller units and unique value. This new economy is based on innovation originating in creativity and design; it is also disrupting long-standing and established employment patterns and bringing to the fore the importance of entrepreneurship. This core unit will bring together creativity, design and entrepreneurship at the conceptual and more practical level. It aims to explore the nature, determinants and consequences of creativity, design and entrepreneurship as well as the interaction between them.

Course Content

Unit 1. Introduction **6 hours**
Preview of the Course, Introduction to the Course, Guest Lecture with U.S. Secretary of Commerce Penny Pritzker – Meaning of Innovation, Entrepreneurial opportunities, Factors influencing the feasibility of an innovation, Innovation strategy: technology-push or market-pull, Product-market fit, How to develop a business model, Walkthrough of the business model canvas, Welcome to Innovation for Entrepreneurs: From Idea to Marketplace.

Unit 2. Customer Discovery and Validation **6 hours**
Customer types, Customer archetypes, Customer segments and business models, Customer segments, value propositions, product features, value mapping, interviewing customer, insights of your customers.

Unit 3: Product Understanding and Marketing. **6 hours**
Customer value, The DNA of customer-centricity, Crossing the chasm, Qualitative and quantitative marketing research, importance and methods of market segmentation, Focusing on the target market, Beyond the chasm, Strategic implications of beyond the chasm, E-commerce: The internet as a selling platform.

Unit 4. Prototyping and Testing. **6 hours**
Planning for prototyping, Rapid prototyping and development, Lean startup MVPs, Choosing a wire framing/UX prototyping tool, Anatomy of an experience map, What you'll learn from user testing, Analytics and insight, Troubleshooting your customer discovery, Levels of a product/service.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSOs) and Course Outcomes (COs)

Course Name:		Venture Ideation						Course Code:		**EIC11001**					
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0
CO2	0	0	0	0	0	3	0	0	0	0	3	0	0	0	0
CO3	0	0	0	0	0	3	0	3	0	0	3	0	0	0	0
CO4	0	0	0	0	0	2	0	3	0	0	3	0	0	0	0
CO5	0	0	0	0	0	3	0	3	0	0	2	0	0	0	0
CO6	0	0	0	0	0	3	0	3	0	0	2	0	0	0	0
Average	0	0	0	0	0	3	0	3	0	0	2	0	0	0	0

1=Weakly mapped
2= Moderately mapped
3=Strongly mapped

GEE12002	**Electrical and Electronics Technology Lab**	L	T	P	C
Version 1.0	**Contact Hours – 45**	0	0	3	2
Pre-requisites/Exposure	Class 12th Level physics				
Co-requisites					

Course Objectives

1. To study basic electroniccomponents
2. To observe characteristics of electronicdevices
3. To study basic electricalcircuits

Course Outcomes

On completion of this course, the students will be able to

CO 1 Remembering: C.O. 1: Recall the key concepts, principles, and theories related to electrical and electronics experiments, including Thevenin's theorem, Norton's theorem, the operation of diodes and transistors.

CO 2 Understanding: C.O. 2: Explain the theories and methodologies behind the experiments, such as superposition theorem, maximum power transfer theorem different meters and illustrating different meters as well as instruments for measurement of voltage, currents, frequency, amplitude, etc.

CO 3 Applying: C.O. 3: Apply the knowledge gained to perform the experiments effectively

and accurately.

CO 4 Analyzing: C.O. 4: Critically analyze and evaluate the experimental results, identifying patterns and relationships between the variables.

CO 5 Evaluating: C.O. 5: Assess the strengths and weaknesses of different experimental approaches and methodologies.

CO 6 Creating: C.O. 6: Develop original ideas and insights based on the experimental results, such as proposing improvements to existing circuits or designing new ones.

Catalog Description

Present technology requires necessary knowledge of ELECTRONICS in most fields. Avionics, Autotronics, Agrotronics, Physics, Process Chemistry, Health Services, etc., already employ components or even whole systems based on Electronics. Thus, there is an increasing number of professionals in these and many other fieldswhoneedadequateknowledgeandtraining.TakenthisintoaccountADAMAShasdevelopedtheBasic ElectronicsandElectricityIntegratedLaboratory,capableofcoveringdifferentlevelsofdifficulty.Itisbased on a series of self-taught modules, each one referring to a specific area ofElectronics.

Course Content

List of experiments (Electrical Part):

1. Verification of Thevenin's theorem and Norton'stheorem.
2. Verification of Superpositiontheorem.
3. Verification of Maximum power transfertheorem.
4. Study of R-L-C seriescircuit.
5. Study of R-L-C parallelcircuit.
6. Performance study of fluorescent, LED, tungsten and carbonlamps.
7. Measurement of power in a three-phase circuit using two-wattmetermethod.

List of experiments (Electronics Part):

1. Familiarization of bread board and electronics elements such as R, L, C, diode, and BJTetc.
2. Familiarization of Function generator and measuring instruments such as CRO andmultimeter.
3. Study the V-I characteristic of PN junction diode and find kneevoltage.
4. Study the input and output characteristic of bipolar junction transistor (BJT): Common emitter (CE) configuration
5. Study the transfer and drain characteristic of junction field-effect transistor (JFET), hence determine the drain resistance, transconductance factor, amplificationfactor.
6. Study the transfer and drain characteristic of MOSFET, hence determine the drain resistance, transconductance factor, amplificationfactor.
7. Realization of digital logic circuit using MOSFET (AND, OR, NOTetc.).

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Course Name: Electrical and Electronics Technology Lab Course Code: GEE12002

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	0	0	3	1	0	0	1	0	0	0	0	0	0
CO2	3	3	0	0	3	1	0	0	1	0	0	0	0	0	0
CO3	3	2	0	0	3	2	1	0	1	0	0	0	0	0	0
CO4	2	3	3	1	2	1	1	0	1	0	0	0	0	0	0
CO5	2	2	3	1	2	1	1	0	1	0	0	0	0	0	0
CO6	2	2	2	1	2	1	1	0	1	0	0	0	0	0	0
Average	2.5	2.5	1.3	0.5	2.5	1.2	0.7	0	1	0	0	0	0	0	0

1=weakly mapped

2= moderately mapped

3=strongly mapped

Model Question Paper

Name: **Enrolment No:**	ADAMAS UNIVERSITY PURSUE EXCELLENCE

Course: GEE12002 – Electrical & Electronics Technology Lab

Program: B.Tech. **Semester: ODD 2020-21**

Time: 03 hrs. **Max. Marks: 50**

SAMPLE QUESTIONS

1.	**A)** Draw the forward V-I Characteristic curve of p-n junction diode with proper circuit connection and also **find** out the knee voltage. **B) Explain** the mechanism of drift & diffusion of carriers.	**U** **R**	**CO3**
2.	**A)** Draw and **compare** the input characteristics of BJT with proper circuit connection (in common emitter configuration) with three different V_{CE} values. **B) What** are the differences between BJT & FET? Explain thermal runway	**U** **R**	**CO2**
3.	**A)** Draw and **compare** the output characteristics of BJT with proper circuit connection (in common emitter configuration) with three different I_B values. **B) What** do you mean by pinch-off voltage? Derive the relationship between α, β and γ.	**U** **R**	**CO2**
4.	**A)** Draw and **compare** the drain characteristics of FET with proper circuit connection with three different V_{GS} values (0v, -1v & -2v). **B) Define** the following terms of a FET with mathematical expressions: **i)** Trans conductance (g_m), **ii)** Drain resistance(r_d).	**U** **R**	**CO2**
5.	**A) i) Estimate** the various resistance values using colour code and compare with measured values.	**Ap** **U**	**CO1**

	ii) Measure the forward & reverse resistance of various diodes. **iii) Identify** the pnp&npn transistors and find out the different terminals. **B) What** are the differences between intrinsic and extrinsic semiconductor? Write approximate value of cut-in voltage for Si and Ge diode.		
6.	**A) Show** the different signals (Sine, Square & Triangle) using function generator and measure the amplitude and frequency of each signal. **B)** Draw and **explain** the common emitter transistor circuit and output characteristics.	**U**	**CO2**
7.	**A)Show** Thevenin's, Norton's, Superposition and Maximum power transfer theorem. **B)What** is load matching? **C)** To **what** type of circuit Thevenin's theorem is applicable? **D) What** is the use of Thevenin's theorem?	**Ap** **R** **R**	**CO1**
8.	**A)Estimate** the resistance, inductance and capacitance for series and parallel RLC circuit using ammeter and voltmeter reading. **B)Measure** power factor for RLC series circuit.	**Ap** **Ap**	**CO4**
9.	**A)What** is the nature (i.e. positive or negative) of the slop of the voltage vs. Resistance characteristics of Tungsten Filament Lamp? **Explain** it briefly. **B)What** is the function of starter? What is the function of choke?	**R**	**CO2**
10.	**A)How** many coils are there in a single in a single phase wattmeter? **B)Which** type of wattmeter is generally used for measuring power in a.c. circuits? **C)What** do you understand by phase sequence in reference to 3-phase circuits? **D)** In a star connected 3-phase balanced load with neutral available, **how** many wattmeters are necessary to measure power?	**R**	**CO5**

MEE12001	**Engineering Workshop**	L	T	P	C
Version 1.0	**Contact Hours – 45**	0	0	3	2
Pre-requisites/Exposure	12th level Physics, Engineering Mechanics				
Co-requisites	--				

Course Objectives:

1. To develop a skill in dignity of labour, precision, safety at work place, team working and development of right attitude.
2. To acquire skills in basic engineering practice
3. To identify the hand tools and instruments
4. To gain measuring skills
5. To develop general machining skills in the students

Course Outcomes:

On completion of this course, the students will be able to

CO1 **CO1 Identifying the basic operations in pattern and mould making**

CO2 Understanding different metal fitting works
CO3 Examining basic forging and welding works
CO4 Illustrating the operations of machine tools
CO5 Reviewing the appropriate tools required for specific operation
CO6 Adapting the safety measures required to be taken while using the tools

Catalog Description:

Engineering Workshop is a place where students acquire knowledge on the operation of various processes involved in manufacturing and production. The Workshop Practice course makes students competent in handling practical work in engineering environment. Students will be expected to be familiar with engineering problems related to practical field.

Course Content

List of Experiments (Any ten)	
1	To make a single piece pattern from the given work piece and dimensions.
2	To make a double piece match pattern from the given dimensions.
3	To make a single piece cylindrical (solid) pattern from the given dimensions.
4	To make a cone from sheet metal as per given dimensions.
5	To make a frustum from sheet metal as per given dimensions.
6	To prepare a sand mold, given the single piece pattern and casting.
7	To prepare a sand mold, given the double piece match pattern and casting with different dimensions and shape
8	To make a square fitting from the given mild steel piece and the dimensions.
9	To make a square fitting from the given mild steel piece and the dimensions.
10	To make a single 'V' butt joint between two metal plates by using ARC welding.
11	To make a square butt joint between metal plates by using gas welding.
12	To perform various types of machining operations (cantering, facing and turning) on a given mild steel rod followed by the given dimensions.
13	To perform various types of machining operations (chamfering, grooving, thread cutting, and knurling) on a given mild steel rod followed by the given dimensions.

Reference Books

1. Workshop Technology by S.K. Garg, 3rd Edition, LP

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Name:		Engineering Workshop					Course Code:		MEE12001						
CO/PO	PO 1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2	0	0	0	1	1	1	1	0	1	0	1	3	0	0
CO2	2	0	0	0	1	1	1	1	0	1	0	1	3	0	0
CO3	2	0	3	0	1	1	1	1	0	1	0	1	3	0	0
CO4	0	3	3	2	1	1	1	1	0	1	0	1	3	0	0
CO5	0	0	3	2	1	1	1	1	0	1	0	1	3	0	0
CO6	0	0	3	2	1	1	1	1	0	1	0	1	3	0	0
Average	2	3	3	2	1	1	1	1	0	1	0	1	3	0	0

1=weakly mapped,
2= moderately mapped,
3=strongly mapped

SEMESTER III

MTH11535	Engineering Mathematics III B	L	T	P	C
Version 1.0	**Contact Hours – 60**	3	1	0	4
Pre-requisites/Exposure	12th level Mathematics and Engineering Mathematics- I &II				
Co-requisites	--				

Couse Objective

1. To understand the fundamental of Laplace, transform and its properties.
2. To develop the concept to solve engineering problems using Laplace transform.
3. To give the basic idea of z-transform and its engineering applications.
4. To empower students to acquire knowledge of some special function such as Hermite, Laguerre and Legendre functions and its importance in engineering sciences.

Couse Outcome

On completion of this course, the students will be able to

CO1. Acquire the fundamental concept of Laplace transform and its properties.

CO2. Acquire the fundamental concept of inverse Laplace transform and its properties.

CO3. Develop knowledge to apply Laplace transform technique in real life problems.

CO4. Acquire the basic idea of z-transform and its engineering applications.

CO5. Understand the concept of Special functions and their importance in engineering sciences.

CO6: Use special functions to represent physical systems and solve mathematical models

Unit I:

Laplace Transform: Definition, Linearity, shifting & scaling properties, Transform of elementary functions, Transform of derivatives and integrals, Multiplication by *t*& division by *t*. Inverse Laplace transform, Convolution theorem, Transform of periodic functions, Unit step function & Dirac delta function, Initial value & final value theorems and its application to solution of ordinary differential

equations and partial differential equations such as heat conduction, wave equation and Laplace equation.

Unit II:

Z – Transform: Sequence, Basic operations on sequences, Definition of z-Transform, Linearity, Change of scale & shifting properties, z-transform of standard sequences, Inverse z-Transform, Multiplication by *n*& division by *n*, Initial value & final value theorems, Convolution of sequences, Convolution theorem, Inverse z- transform by partial fraction, power series and residue methods and its application to solution of difference equations.

Unit III:

Special Functions: Moment, functionals and orthogonality, Existence of orthogonal polynomial systems, The fundamental recurrence formula, Zeros of orthogonal polynomials, Hermite Polynomial, Laguerre Polynomial, Legendre Polynomial.

Text Books

1. B.V.Ramana, *Higher Engineering Mathematics*, McGraw Hill Education, 2017.
2. H. K.Das,*Advanced Engineering Mathematics*, S Chand, 2007.

Reference Books

1. C. B. Gupta, S. R. Singh and Mukesh Kumar, *Engineering Mathematics for Semesters I and II*, McGraw Hill Education, 2017.
2. C. B. Gupta, S. R. Singh and Mukesh Kumar, Engineering Mathematics for Semesters III and IV, McGraw Hill Education, 2017.
3. T.S. Chihara, An introduction to orthogonal polynomials, Dover Publications Inc., 2011.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Engineering Mathematics – III B	Course Code:	MTH11535

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	3	3	3	0	0	0	0	0	0	0	3	0	0	0
CO2	0	3	3	3	0	0	0	0	0	0	0	3	0	0	0
CO3	0	3	3	3	0	0	0	0	0	0	0	3	0	0	0
CO4	0	3	3	3	0	0	0	0	0	0	0	3	0	0	0
CO5	0	3	3	3	0	0	0	0	0	0	0	3	0	0	0
CO6	0	3	3	3	0	0	0	0	0	0	0	3	0	0	0
Average	0	3	3	3	0	0	0	0	0	0	0	3	0	0	0

PC- I (Analog and Digital Electronics)

BME11001	**Prof. Core- I (Analog and Digital Electronics)**	L	T	P	C
Version 1.0	**Contact Hours - 45**	3	0	0	3
Pre-requisites/Exposure	**Basic Electronics:** Semiconductor Device				
Co-requisites					

Course Objectives

1. To introduce components such as diodes, BJTs and FETs.
2. To give Understand of various types of amplifier circuits.
3. To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
4. To understand the concepts of combinational logic circuits and sequential circuits.

Couse Outcome

On completion of this course, the students will be able to

CO1. Analyze BJT biasing circuits and determine operating points for stability

CO2. Understand and apply operational amplifiers and timer circuits in linear applications

CO3. Convert and manipulate number systems and binary codes used in digital systems

CO4. Apply Boolean algebra and logic gates for simplification of digital logic expressions

CO5. Design and implement combinational logic circuits for arithmetic and code conversion tasks

CO6: Design sequential logic circuits using flip-flops, counters, and shift registers

Course Description

The course has been designed to introduce fundamental principles of analog and digital electronics. The students completing this course will understand basic analog and digital electronics, including semiconductor properties, operational amplifiers, combinational and sequential logic, and analog-to-digital digital-to-analog conversion techniques. Finally, students will gain experience in the design of analog amplifiers, power supplies, and logic devices.

All the lectures will be devoted to discussions of basic theories and advanced topics, focusing on the practical implementation of knowledge. Classes will be conducted by lecture as well as PowerPoint presentation and audiovisual virtual lab session as per requirement. The tutorials will familiarize the student with practical problem-solving techniques led by the course coordinator. The student will strongly grab the basic concepts of the subject via exercise and discussions with the coordinator.

Course Content

Module 1: Biasing of BJT:

BJT characteristics & parameters, all biasing circuits, analysis of above circuits and their design, variation of operation point and its stability. Introduction to FET and comparison with BJT.

Module 2: Operational Amplifiers and Linear Applications:

Block diagram representation, ideal op-amp, equivalent circuit, open-loop configuration, transfer characteristics, op-amp with negative feedback, frequency response op-amp IC741 specifications, basic op-amp applications: adder, scalar, subtractor, difference amplifier, I-V converter, V-I converters, integrator, differentiator, instrumentation amplifier using 2 and 3 op-amp stages. IC555 timer, multivibrators: astable, monostable and bistable.

Module 3: Number Systems and Codes: Binary, octal, decimal and hexadecimal number systems and their conversion, binary addition and subtraction.

Module 4: Basic theorems and properties of Boolean algebra, standard SOP and POS forms, simplification of Boolean functions using K-map (up to 4 variables), logic gates: NOT, AND, OR, NAND, NOR, EX-OR and EX-NOR gates, realization of simple Boolean functions using logic gates.

Module 5: Combinational Logic Design: Introduction, half and full adder, half and full subtractor, four bit binary adder, one digit BCD adder, code conversion, multiplexers and demultiplexers, decoders, 4-bit magnitude comparator.

Module 6: Sequential Logic Design: Introduction to sequential circuits, SR, JK and D flip-flops, truth tables and basic applications, asynchronous and synchronous counters, modulo counters, shift registers (SISO, SIPO, PISO and PIPO), applications of counters and shift registers.

TextBooks:	
1	RobertL.Boylestad andLouisNashelsky,ElectronicDevicesand CircuitTheory,Pearson,2013.
2	RamakantA.Gayakwad,Op-amps andLinearIntegratedCircuits,PearsonEducation,2015.
Reference Books:	
1	R.P.Jain,ModernDigitalElectronics,4thEd.,McGrawHillEducation,2009.
2	M.MorrisMano,DigitalLogicandComputer Design,PearsonEducation,2004
3	MartinRoden,GordonCarpenterandWilliamWieserman,ElectronicDesign:FromConcepttoReality, 4thEd.,DiscoveryPress,2002.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term

Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: Prof. Core- I (Analog and Digital Electronics) Course Code: BME11001

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO2	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO3	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO4	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO5	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO6	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
Average	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3

PC- II (Anatomy & Physiology)

BME11002	**Prof. Core- II (Anatomy & Physiology)**	L	T	P	C
Version 1.0	**Contact Hours - 45**	3	0	0	3
Pre-requisites/Exposure	Basic idea about basic life science				
Co-requisites	Class 12th level basic idea of Anatomy & Physiology				

Course Objectives

1. In-depth understanding of anatomy and physiology of the cardiovascular system, the pulmonary system, the renal system, the digestive system, the nervous system, the muscular system and the skeletal system.
2. Understand the corresponding structure function relationship of these physiological systems.
3. Make measurements on and interpret data of physiological processes in living systems.
4. Explain mechanisms of communication, integration and homeostasis involved in physiological parameters and energy balance.
5. Understand and postulate physiological concepts based on anatomical information
6. Enable students to develop their critical reasoning skills in the field of Engineering

Physiology & anatomy.

Couse Outcome

On completion of this course, the students will be able to

CO1. Describe the organization of the human body and cellular structures

CO2. In-depth understanding of anatomy and physiology of heart and blood vessel, the lung, the renal system, the digestive system, the nervous system, the muscular system and the skeletal system extended up to tissue and organs

CO3. Understand and relate the corresponding structure function relationship of these physiological systems

CO4. Make measurements on and interpret data of physiological processes in living systems

CO5. Explain mechanisms of communication, integration and homeostasis involved in physiological parameters and energy balance

CO6. Enable students to understand and postulate physiological concepts based on anatomical information and develop their critical reasoning skills in the field of Engineering Physiology & anatomy

Course Description

The course has been designed to introduce fundamental principles of anatomy and physiology. The students completing this course will understand understanding of anatomy and physiology of the cardiovascular system, the pulmonary system, the renal system, the digestive system, the nervous system, the muscular system and the skeletal system. Finally, students will gain experience in their critical reasoning skills in the field of Physiology & anatomy

Course Content

Module 1: Organization of Human Body: Anatomical position, terminology, regions and planes. Basic anatomy and physiology of cells, Tissues (epithelial, connective, muscle, nervous, blood, glands), Permeability of cell membrane, genesis of membrane potential excitation of cell

Module 2: Skeletal and muscular System: Functions of skeletal system, Anatomy of long bone, Bonehistology, Naming all bones of axial and appendicular skeleton, Formation, growth and repair, Structural and functional classification of joints, Types of movement, Calcium homeostasis. Functions of muscular system, Names of all major muscles, Origin,

insertion and action, Sliding Filament Model, Neuromuscular junction, Structure (gross and microscopic), Physiology of muscle contraction, Fiber types, Exercise physiology.

Module 3: Cardiovascular and Lymphatic/Immune System: Functions of circulatory system, Heart structures (chambers, valves, and vessels), Circulatory routes (systemic, pulmonary, coronary and hepatic portal), Blood vessels and pressure, Blood components, function and typing, Blood clotting, Regulation and conduction (EKG). Functions of lymphatic system, Structures (vessels, nodes, cells), Lines of defense, Humoral immune response, Cell mediated immune response, Immune cell types.

Module 4: Digestive & Excretory System: Organization of GI System, digestion andabsorption, stomach, intestine, liver, pancreas, structure of kidney and nephron, mechanism of urine formation, micturition, skin and sweat gland,temperature regulation.

Module 5: Respiratory System: General structure of respiratory system and functions- Lungs and Trachea, Respiratory Pathways, Functional aspects and mechanics of respiration, Mechanics and regulation of breathing, Gas exchange and gas laws, Hypoxia, effect of exercise.

Module 6: Nervous System: Functions of nervous system, Nerve cell anatomy, Neural physiology (action potential, synaptic transmission, Na/K pump), Brain anatomy and hemispheres, Spinal cord anatomy, reflex arc, PNS (autonomic and somatic), Sensory motor nerve functions.

TextBooks:	
1	Charles E.Tobin,BasicHumanAnatomy,McGrawHillPublication.
2	J.H.GreenAnIntroductiontoHumanPhysiology.
	H.B.CharlesandB.N.Taylor;ThePhysiologicalBasisofMedicalPractice.WilliamandWilkins, Baltimore,1985
Reference Books:	
1	C.A.Keeleand EricNeil;SamsonWright'sAppliedPhysiology.ELBS,London,1984.
2	S.West,E.R.Todd,W.S.Masonand H.J.T.VanBruggen;TextBookofBiochemistry. MacmillanCo.,1976.
3	A.G.Guyton;Textbookof MedicalPhysiology;Saunders,Philadelphia,1986.
4	AnatomyandPhysiologyinHealthandIllness:RossandWilson(ELBSpub).
5	HumanPhysiologybyA.Vander,J.ShermanandD.LucianoMcGrawHill.
6	PrinciplesofAnatomyandPhysiology:TortoraandGrabowski.(Haper Collinpub.).

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:		Prof. Core- II (Anatomy & Physiology)						Course Code:		BME11002					
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	1	2	3	3	3	2	0	0	0	3	3	3	3	3
CO2	2	1	2	3	3	3	2	0	0	0	3	3	3	3	3
CO3	3	3	3	3	2	2	1	1	0	1	3	3	3	3	3
CO4	3	3	3	3	2	3	2	3	0	0	3	2	1	3	3
CO5	3	2	3	3	2	2	2	1	0	3	2	1	2	3	3
CO6	3	0	3	3	2	2	3	1	0	0	3	2	3	3	3
Average	2.8	2	2.67	3	2.3	2.5	2	1.5	0	2	2.8	2.3	2.5	3	3

PC- III (Signals and Network Analysis)

BME11003	Prof. Core- III (Signals and Network Analysis)	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	1. 12th level Mathematics 2. Knowledge of 12th level Physics				
Co-requisites					

Course Objectives

1. To familiarize students with Resonance in Circuits and relevant parameters and methods for evaluating the same.

2. To introduce students the methods of Mesh Current and Node Voltage analysis and their application.

3. To describe Network Theorems and their applications.

4. To illustrate graph theory and its application in estimating electrical parameters in the circuit.

5. To introduce students with coupled circuits and their methods of analysis.

6. To introduce students with transient circuits and describe the methodology to evaluate relevant electrical parameters.

7. To highlight the application of Laplace & Inverse Laplace transform in analyzing circuits

---

Couse Outcome

On completion of this course, the students will be able to

CO1. Classify signals and systems and analyze their basic properties

CO2. Apply Fourier series and Fourier transform to signal analysis

CO3. Use network topology concepts for systematic circuit analysis

CO4. **Analyze electrical networks using circuit laws and theorems**

CO5. Determine parameters of one-port and two-port networks

CO6. Design analog filters for signal conditioning applications

Course Description

The course has been designed to introduce fundamental principles of Signals and Network Analysis. The main objective of learning this course on biomedical signals and systems for biomedical engineering students is to acquire knowledge for analyzing the continuous time discrete time signals & systems and its bio signal applications.

Course Content

Module 1: Introduction of signals and systems: signal and system types and classifications, basic Operations on signals, Parseval's theorem, step response, impulse response and convolution integral, concepts of correlation, power spectral density.

Module 2: Periodic and aperiodic signal analysis: Periodic signal analysis: Fourier series and properties; Aperiodic signal analysis: Fourier Transform - its properties and sinusoidal steady state analysis of systems

Module 3: Elements of electrical network and analysis: Dependent and independent sources, active and passive components; linear and nonlinear circuit, lateral and bilateral circuit, lumped and distributed circuit, Generalized formulation of KCL, KVL, State Variable descriptions; Thevenin, Norton, Maximum Power Transfer, Tellegen and Reciprocity Theorems; classical differential equations for description of transient conditions of Network; Solutions of linear time invariant networks with initial conditions; Unilateral and Bilateral Laplace Transforms and properties; Transient analysis of RL and RC circuits using Laplace Transform; Network functions: poles, zeros, transfer function.

Module 4: Network Topology: Graph theory: Tree, Co-tree, fundamental cut-set, fundamental loop analysis of network

Module 5: One and two port network parameters and functions: Z, Y and ABCD, parameters, driving point and transfer impedances and admittances.

Module 6: Analog filter design: HP, LP, BP, BR Filter, Butterworth, SallenKey,frequency transformation and scaling.

TextBooks:	
1	"Signals&Systems"byOppenheim, WillskyandNawab,Pearson, PHI
2	"NetworkAnalysis"byM.E.VanValkenburg,ThirdEdition;PrenticeHall,1986.
	"Network Analysis&Synthesis"byF.F.Kuo;JohnWiley&SonsInc.
Reference Books:	
1	"Signalsandsystems",byANagoorKani,TataMcGrawHill,IndianReprint,2010
2	"DigitalSignalProcessing",byProakis:Pearson
3	"Fundamental ofelectriccircuittheory",byD.Chattopadhyay and P.C.Rakshit,S.Chand,2009

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: Prof. Core- III (Signals and Network Analysis) Course Code: BME11003

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO2	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO3	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO4	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO5	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO6	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
Average	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3

PC- IV Biomedical sensors and Transducers

BME11004	**PC- IV Biomedical sensors and Transducers**	L	T	P	C
Version 1.0	**Contact Hours - 45**	3	0	0	3
Pre-requisites/Exposure	Knowledge of 12th level Physics, biology				
Co-requisites	Knowledge of mathematics				

Course Objectives:

1. Provide a thorough understanding of the working principles, classifications, and characteristics of sensors and transducers.
2. Explain the role of sensors in biomedical instrumentation for measuring physiological variables.
3. Familiarize students with mechanical, thermal, optical, acoustic, and chemical sensing technologies.
4. Introduce biopotential electrodes and their applications in medical diagnostics.
5. Explore modern trends in smart sensors, wearable devices, MEMS, and nanotechnology-based sensors.
6. Develop practical skills in sensor selection, calibration, and integration for medical applications.

Couse Outcome

On completion of this course, the students will be able to

CO1: explain the transduction principle, classifications, characteristics of different transducers and its biomedical applications.

CO2: Correlate the concepts, types, working mechanism and practical applications of important electrodes for acquiring and recording various physiological parameters.

CO3: Apply the basic principles of bio-sensing in terms of biological, chemical, and optical/photonic responses.

CO4: Categorize the different biological sensors and compare different techniques with sensitivity & selectivity and critically evaluate a selected application of a biosensor.

CO5: Determine the bioelectrical signals and physiological variables using biosensors and bioelectrodes.

CO6: Evaluate enzyme-based and optical biosensors for biomedical analysis

Course Description:

This course introduces the fundamental principles, design, and applications of sensors and transducers used in medical devices and biomedical instrumentation. It covers mechanical, thermal, optical, acoustic, and chemical sensors, along with biopotential electrodes and modern advancements in smart and wearable sensors. Emphasis is placed on understanding sensor characteristics, signal conversion, and their role in monitoring physiological parameters such as pressure, temperature, blood flow, ECG, EEG, and glucose levels. The course combines theoretical knowledge with practical applications to prepare students for careers in biomedical engineering and healthcare technology.

Course Content

Unit-1 Introduction of Transducers

Basics of Various Biological Sensing Mechanisms in Human Body; Introduction to Transducers and Sensors, Classification, Principle of Transduction, Performance Characteristics of Transducers: Operating Range, Accuracy, Precision, Stability, Fatigue.

Unit-2 Pressure, Displacement and Temperature Transducers

Resistive Strain Gauges, Strain Gauge, Strain Gauge Bridge. Piezoelectric Phenomena and Materials, Output Voltage Expression of Piezo Crystal, Equivalent Circuit of Piezoelectric Transducers and Dynamic Characteristics. Potentiometric Transducers, Capacitive, Inductive, LVDT Transducers-Principle, Equivalent Circuit, Linearity Issues, Capacitive Displacement Transducers, Digital Encoders. Thermo Resistive- Resistance Temperature Detectors (RTDS), Thermistor. Thermo Electric -Thermocouple, PN Junction Diode. Non-Contact Type Temperature.

Unit-3 Measurement of Biological Parameters

Units of Pressure, Requirement for Pressure Measurement, Physiological Ranges for Pressure Measurement, Reference Points for Pressure Measurement. Direct Pressure Measurement-Catheter and Diaphragm, Indirect Pressure Measurement –Measurement of Blood Pressure Using Sphygmomanometer, Detection of Korotkoff's Sound, Oscillometric Method. Indirect

Measurement of Instantaneous Arterial Pressure. Electromagnetic Flow Meter and Ultrasound Flow Meter.

Unit-4 Chemical Biosensors

Electrochemical sensors for ions and dissolved gases , Half-Cell Potential, Reference Electrodes - Hydrogen Electrodes - Silver-Silver Chloride Electrodes- Calomel Electrodes. Measurement of Ph- Glass Ph Electrodes. Measurement of pO2, Measurement of pCO2 - Conductivity Measurement Transducer. Enzyme Electrode - Construction – ISFET for Glucose, Urea. Electrolytic Sensors - Optical Sensor - Fiber Optic Sensors. Microbial Sensor, Enzyme Immobilization of Chemical Analyses.

Textbooks / References:

1. A. K. Sawhney, *A Course in Electrical and Electronic Measurements and Instrumentation.*
2. D. Patranabis, *Sensors and Transducers.*
3. John G. Webster, *Medical Instrumentation: Application and Design.*
4. R. S. Khandpur, *Handbook of Biomedical Instrumentation.*

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Core-IV Biomedical Sensors and Transducers	Course Code:	BME11004

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	0	3	1	0	0	0	0	2	3	1	3
CO2	3	2	3	2	0	3	1	0	0	0	0	2	3	1	3
CO3	1	2	3	3	3	2	1	0	0	0	1	2	1	2	3
CO4	3	3	3	3	3	2	1	0	0	0	1	1	1	3	3
CO5	0	2	0	3	2	1	0	0	0	0	0	0	2	3	3
CO6	2	2	3	2	2	1	0	0	0	0	0	1	1	2	3
Average	2	2.1	3	2.5	1.5	2	1	0	0	0	1	1.6	1.8	2	3

PC-III Lab (Signals and Network Analysis Lab)

BME12005	**Prof. Core-I Lab (Signals and Network Analysis Lab)**	L	T	P	C
Version 1.0	**Contact Hours - 30**	0	0	3	2
Pre-requisites/Exposure	1. 12th level Mathematics 2. Knowledge of 12th level Physics				
Co-requisites	--				

Course Objective

1. To familiarize students MATLAB Software and its application in circuit analysis.

2. To introduce students in evaluating electrical parameters in resonant circuits using MATLAB.

3. To implement MATLAB in verification of Network theorems.

4. To familiarize students in measuring electrical parameters in transient circuits using MATLAB.

5. To introduce students with the generation of various waveforms using MATLAB.

6. To apply MATAB in evaluating impedance and admittance parameters in a circuit.

7. To familiarize students with poles & zeros concepts and the techniques in evaluating the same.

8. To enumerate application of Laplace transform and its inverse in analysis of circuits.

Course Outcome

After completion of this course the students will be able to

CO1. **Apply signal generation techniques and analyze periodic and aperiodic signals using MATLAB.**Verify and analyze Network Theorems to electrical networks using MATLAB.
CO2. **Analyze and compute the Laplace Transform and Inverse Laplace Transform for different signals and functions.**
CO3. **Design transfer functions, compute poles and zeros, and analyze system responses.**
CO4. **Perform convolution and deconvolution for signals, and apply these techniques to system analysis.**
CO5. **Design and analyzeanalog filters using MATLAB, including the design of Butterworth filters.**
CO6. **Understand and compute network parameters (Z, Y, ABCD) for two-port networks.**

Course Description

The course has been designed to introduce fundamental principles of Signals and Network Analysis. The main objective of learning this course on biomedical signals and systems for biomedical engineering students is to acquire knowledge for analyzing the continuous time discrete time signals & systems and its bio signal applications.

Course Content

List of experiments

1. Familiarization with MATLAB
2. Generation of common Periodic (Sinusoidal, Square, sawtooth), common aperiodic (Gaussian Pulse, and Damped Sinusoidal Signal), impulse, Unit Step, ramp signal using MATLAB 3.Generation of Delayed Unit Step and Delayed Unit Impulse Signal.

3. Determination of Laplace Transform and Inverse Laplace transform of variables, functions.
4. Generate Transfer Function of 1st order and 2nd order system (including feedback) and compute Poles and zeros of a given TF in S domain.
5. Perform Convolution and Deconvolution one sinusoidal with one unit step signal.
6. 7. Determine the convolution of
7. i) Two vectors u = [1 2 3 4], v = [10 20 30], also recover vector v after deconvolving the result with u.
8. ii) A sinusoidal signal with a random noise.
9. 8. Determination of impulse response of the system governed by the transfer function G(S) = 1/(s2+s+1) . Determine the step response of the circuit defined by an impulse response of h(t)= 5e-t sin2t u(t).
10. 9. Design an analog high pass Butterworth filter of the order 4th, with a Sampling frequency of 1000 Hz, cutoff frequency of 300 Hz, which corresponds to a normalized value of 0.6.
11. 10. Determine the h and ABCD parameters of a two port network.
12. 11. Determine the Z parameters and Y of a two port network.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: Prof. Core-I Lab (Signals and Network Analysis Lab) Course Code: BME12005

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO2	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO3	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO4	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO5	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3

CO6	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
Average	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3

BME12006	**Prof. Core-III Lab Analog and Digital Electronics Lab**	L	T	P	C
Version 1.0	**Contact Hours - 30**	0	0	2	1
Pre-requisites/Exposure	1. 12th level Mathematics 2. Knowledge of 12th level Physics				
Co-requisites					

Course Objective

1. To illustrate the students different electronic circuit and their application in practice.
2. To impart knowledge on assessing performance of electronic circuit through monitoring of sensitive parameters.
3. To understand the principle of operation of different oscillators circuits.
4. To understand the design process of various basic linear application circuits using OP-AMP.
5. To understand and design circuits using 555 Timer.

Course Outcome

After completion of this course the students will be able to

CO1. **Understand the fundamentals of electronic circuits and their practical applications.**
CO2. **Analyze the performance of electronic circuits using appropriate testing strategies and instruments.**
CO3. **Design and implement basic electronic circuits such as amplifiers, adders, and subtractors using OP-AMPs and other components.**
CO4. **Evaluate discrepancies between theoretical concepts and practical observations in circuit performance.**
CO5. **Demonstrate safe and efficient wiring and instrumentation practices in circuit design and testing.**
CO6. **Apply electronic circuit principles to real-world applications, focusing on innovative problem-solving and experimentation.**

Course Description

In this course the working of various rectifier circuit is explained. In addition, students learn how various mathematical operations have done using OP-AMP (IC-741), different types of oscillators and their working and characteristics of various multi vibrator using IC 555 timer.

Course Content

List of Experiments:

1. Study the input and output characteristics of a BJT in Common Emitter (CE) configuration and determine current gain (β).

2. Design and analyze a voltage-divider bias circuit and study the stability of the operating point.

3. Study the frequency response of a single-stage RC-coupled CE transistor amplifier and determine gain and bandwidth.

4. Design and verify inverting and non-inverting amplifiers using IC 741 Op-Amp.

5. Design and study Op-Amp based summing amplifier (Adder) and difference amplifier (Subtractor).

6. Design and verify integrator and differentiator circuits using IC 741.

7. Design and study a three Op-Amp instrumentation amplifier and determine its gain.

8. Design and verify astable multivibrator using IC 555 timer and measure frequency and duty cycle.

9. Design and verify monostable multivibrator using IC 555 timer and measure pulse width.

10. Verify the truth tables of basic logic gates (AND, OR, NOT, NAND, NOR, XOR and XNOR) using digital ICs.

11. Implement and verify Half Adder and Full Adder circuits.

12. Implement and verify Half Subtractor and Full Subtractor circuits.

13. Study the operation of Multiplexer, Demultiplexer and Decoder circuits.

14. Verify the operation of SR, JK, D and T Flip-Flops and obtain their truth tables.

15. Design and verify asynchronous/synchronous counters and study shift registers (SISO, SIPO, PISO and PIPO).

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: Prof. Core-III Lab (Analog and digital electronics Lab) Course Code: BME12006

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO2	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO3	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO4	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO5	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
CO6	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3
Average	0	3	0	3	3	0	0	0	0	0	0	0	3	0	3

BME12007	**Prof. Core-II Lab Basic Anatomy and physiology lab**	L	T	P	C
Version 1.0	**Contact Hours - 30**	0	0	2	1
Pre-requisites/Exposure	12th level biology				
Co-requisites					

Course Objectives

1. To familiarize students with the gross anatomy of the human body using models, charts, and specimens.

2. To develop the ability to identify and describe tissues, organs, and organ systems through histological and practical observations.
3. To understand basic physiological principles through experiments related to cardiovascular, respiratory, nervous, and other body systems.
4. To develop laboratory skills such as specimen handling, microscope usage, and data recording.
5. To integrate theoretical concepts of anatomy and physiology with practical laboratory experiences for a comprehensive understanding of human biology.

Couse Outcome

On completion of this course, the students will be able to

CO1: Identify and describe human anatomical planes, regions, and skeletal structures.

CO2: Perform basic hematological procedures and interpret the results.

CO3: Determine blood groups using standard agglutination techniques.

CO4: Perform red and white blood cell counts using hemocytometry

CO5: Measure and interpret arterial blood pressure using a sphygmomanometer.

CO6: Prepare and stain peripheral blood smears to identify blood cell morphology.

Course Description

The Anatomy and Physiology Laboratory provides students with hands-on experience to explore the structure and function of the human body. Through a series of practical sessions involving anatomical models, preserved specimens, histological slides, and basic physiological experiments, students will learn to identify body structures, understand organ systems, and observe physiological responses. This lab complements theoretical coursework and emphasizes the application of knowledge in clinical and biomedical contexts.

List of experiments

1. Anatomical Planes and Regions
2. The Skeleton System – Axial System
3. The Skeleton System – Appendicular System
4. Determination of Bleeding Time
5. Determination of Clotting Time
6. Detection of Blood Group
7. R.B.C. Counting
8. Total W.B.C. Counting

9. Detection of Hemoglobin
10. Preparation of Blood Film & Staining
11. Measurement of Blood Pressure

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: Prof. Core-II Lab (Basic anatomy and physiology Lab) Course Code: BME12007

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	0	0	0	0	0	0	0	0	3	3	3
CO2	3	3	2	2	2	1	0	1	1	0	0	1	3	3	3
CO3	3	3	2	2	2	1	0	1	1	0	0	1	3	3	3
CO4	3	3	2	2	2	1	0	1	1	0	0	1	3	3	3
CO5	3	3	2	2	2	1	0	1	1	0	0	1	3	3	3
CO6	3	3	2	2	2	1	0	1	1	0	0	1	3	3	3
Average	3	3	1.8	2	2	1	0	1	1	0	0	1	3	3	3

IDP14001	Interdisciplinary Project	L	T	P	C
Version 1.0	Contact Hours – 45	0	0	5	3
Pre-requisites/Exposure	Knowledge of Basic English				

Co-requisites	Knowledge of Basic Computer Skills

Course Objective

1. To develop a student's knowledge of and appreciation for the interdisciplinary nature of knowledge and learning and importance
2. Value of integrating knowledge and perspectives from multiple disciplines as a means to evaluating and understanding complex topics, problems, issues, phenomena, and events
3. Competencies learned during the educational process and to apply these competencies in a real-world application.

Course Outcome

Upon successful completion of the course, students will be able to

CO1. Identify the unique advantages of integrative research and learning

CO2. Understand the fundamentals of research methods and practices of various academic disciplines

CO3. Examine current issues and concerns

CO4. Explain the importance of ethics in research process

CO5. Review the inter-disciplinary systems of research documentation

CO6. Collaborate with team members to develop the required project

Course Description

This course will develop a student's knowledge of and appreciation for the interdisciplinary nature of knowledge and learning and importance and value of integrating knowledge and perspectives from multiple disciplines as a means to evaluating and understanding complex topics, problems, issues, phenomena, and events with competencies learned during the educational process and to apply these competencies in a real-world application

Course Content

1. After discussion with the Project Advisor(s), each student shall prepare an initial outline of

their assigned project indicating the major sections of discussion, list the principal research sources for each section, and explain the overall objective of the project, including a justification of the interdisciplinary nature of the work.

2. Each student shall meet with the Project Advisor(s) regularly as per the weekly Time-Table. Other meetings may be scheduled at the discretion of the Project Advisor(s) at mutually agreed upon timings.
3. Typically, the progress will include a combination of industrial and academic mentoring , self study sessions, case studies, trend studies, presentation by students, interactive sessions, industrial visits etc.
4. Regular submission of progress reports shall be required of each student-group as notified through the Project Advisor(s) from time to time.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	**50**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: Interdisciplinary Project Course Code: IDP14001

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	3	0	0	0	0	0	0	0	0	3	3	3	0
CO2	3	0	3	0	0	0	0	0	0	0	0	3	3	3	0
CO3	3	0	3	0	0	0	0	0	0	0	0	3	3	3	0
CO4	3	0	3	0	0	0	0	0	0	0	0	3	3	3	0
CO5	3	0	3	0	0	0	0	0	0	0	0	3	3	3	0
CO6	3	0	3	0	0	0	0	0	0	0	0	3	3	3	0
Average	3	0	3	0	0	0	0	0	0	0	0	3	3	3	0

SOC14100	Community Service	L	T	P	C
Version 1.0	**Contact Hours – 15**	-	-	-	1
Pre-requisites/Exposure	Knowledge of Basic English				
Co-requisites	Knowledge of Basic Computer Skills				

Course Objectives

1. To familiarise the students on the concept 'giving back to the society'.
2. To familiarize the students on the issues faced by marginalized communities.
3. To provide an experiential platform to the students on any one or two issues as an internship.

Course Outcomes

On completion of this course, the students will be able to

CO1: **Utilize** the concept of social responsibility through an internship.

CO2: **Acquire** hands on experience in 'giving back to the society' through the concept of social responsibility through an internship.

Course Description

Along with Intelligent Quotient, it is important for students to enhance their Emotional Quotient as well. The Social Internship offers opportunity to the student to be empathetic towards social issues facing our society. To help and support the affected community / cause through a field internship is the essence of the course in 'giving back to the society'.

Course Content

Unit I:

Introduction to the course. A brief on social issues facing the society with both global and Indian examples.

Unit II:

Minimum 24 hours of field work on a social issue and helping the marginalized / affected community / cause with photographs and testimonies.

Unit III:

Submission of individual reflection on the social service rendered.

The benefits that accrue to the students are

A.) Subjective

1. Psychosomatic benefits: Volunteering increases overall life satisfaction and also helps to relive stress and acts as an anti-depressant.
2. Intellectual benefits: Enhances knowledge through new experiences, and develops communication skills.
3. Career benefits : Enhances career prospects by acquisition of work-related skills, builds good references for employers and provides a forum to network with future potential employers. It also The experience allows gained helps students to take up leadership positions. Letters of recommendation can also be easily sought. Research shows that students who indulge in volunteer word perform better in studies as it invigorates their passion for learning
4. Personal benefits : Real world skills like leadership, problem-solving, collaboration with others, time management and communication skills, learn patience and empathy.
5. Connect learning to real world and enables deeper and lifelong learning.

B.) **Community**

1. Collective benefits: Strong interpersonal bonds are created, and leads to increased civic and social awareness and responsibility.

Further Reading :

1. Tadevosyan, Gohar & Schoenhuth, Michael. Participatory Research Approach : Principles, Challenges and Perspectives. http://ysu.am/files/01G_Tadevosyan_M_Schoenhuth.pdf

2. Bergold, Jarg & Thomas Stefan. Participatory Research Methods: A Methodological Approach in Motion http://www.qualitative-research.net/index.php/fqs/article/view/1801/3334

Plan of Work

1. Reading on social issues facing the society with both global and Indian examples.
2. Selecting an issue where the student wishes to contribute and wants to make a difference.
3. Areas - The internship may be broadly completed by getting in touch with NGO in your city / town / Police / Municipal Corporation / Local Gram Panchayat / Hospital / State Health Department / Women & Child Development Centre / CSR departments of Corporates /school / Old Age Home / Orphanage / Literacy Drive / Aanganwadi Centres / etc.
4. **Online Discussion –** Through discussion, students elaborate their preferred area of work with reference to the Global Scenario and India. Reason for choosing that area also needs and resources of the people in their area of Social Internship and also submit the testimonials, which include signature of the authority where students initiated their work, or the signature of the authority in whose area students are currently working or photographs of work (photographs must include students working).
5. **Final Report Submission** - Submission of the Testimonials include signatures of the authorities you have worked with, or the signature of the authority in whose area you have worked or photographs of your work (photographs must include you working). Students' accomplishment in their area of operation along with the major successes student experienced and major challenges faced.
6. Students will submit the complete elaborated report along with testimonials and completion certificate in the form of signed Template

- The registration for all students will open twice, during winter and summer breaks. They may enroll for the internship in either of the two breaks.
- The student will have to submit a continuous record of their 10 to 15 days internship in the form of photographs and testimonies (wherever required).

Mode and Scheme of Online Evaluation:

Modes of Evaluation: Online – Quiz / Assignment / Discussions / Case Studies

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: Community Service Course Code: SOC14100

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	0	0	0	3	0	0	3	0	0	3	0	0	0
CO2	0	0	0	0	0	3	0	0	3	0	0	3	0	0	0
CO3	0	0	0	0	0	3	0	0	3	0	0	3	0	0	0
CO4	0	0	0	0	0	3	0	0	3	0	0	3	0	0	0
CO5	0	0	0	0	0	3	0	0	3	0	0	3	0	0	0
CO6	0	0	0	0	0	3	0	0	3	0	0	3	0	0	0
Average	0	0	0	0	0	3	0	0	3	0	0	3	0	0	0

SEMESTER IV

BME11008	Prof. Core- IV (Basic Clinical Science)	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	Knowlende of biology, chemistry, physics				
Co-requisites	--				

Course Objectives:

1. To understand the structure and function of key biomolecules and enzymes in biological systems.
2. To learn essential laboratory techniques in clinical biochemistry and microbiology.
3. To apply knowledge of diagnostic tests for analyzing blood, urine, and tissue samples.
4. To understand microbial classification, pathogenicity, and diagnostic methods.
5. To study the mechanisms of cell injury, inflammation, neoplasia, and disease pathophysiology.

Couse Outcome

On completion of this course, the students will be able to

CO1: Demonstrate foundational knowledge of biomolecules and metabolism in health and disease.

CO2: Interpret biochemical test results and correlate them with common clinical conditions

CO3: Explain the structure, classification, and pathogenesis of major microorganisms.

CO4: Apply principles of sterilization, immunity, and antimicrobial therapy in clinical settings.

CO5: Describe cellular injury mechanisms, inflammation, and Pathophysiology of common diseases

CO6: Correlate pathological findings with diseases affecting major organ systems.

Course Description:

This course provides foundational knowledge in biochemistry, microbiology, and pathology relevant to clinical practice. It covers biomolecular functions, lab techniques, disease diagnostics, and microbial identification. Emphasis is placed on interpreting biochemical and pathological test results to support clinical decision-making.

Course Content

Module 1: Introduction to Biochemistry Structure and function of biomolecules: carbohydrates, proteins, lipids, nucleic acids, Enzymes: classification, mechanism of action, factors affecting enzyme activity, clinical significance, Vitamins and cofactors – functions and deficiency disorders, Acid-base balance and buffers in biological systems

Module 2: Basics techniques of clinical biochemistry: Laboratory equipment, Principle & Applications of Immunoassay techniques, Electrophoresis, Polymerase Chain Reaction,

Applied clinical biochemistry: Laboratory principles and safety measures, Specimen collection, Processing of tissue, blood and urine, Full blood count, Blood glucose regulation and role of hormones, estimation of glucose, Lipid profile estimation, Bone profile estimation, Protein estimation, Renal Function Tests, Gastric Function Test, Liver Function Tests, Cardiac Profile Tests.

Module 3: Basics of clinical microbiology: Laboratory & Aseptic Techniques, Culturing Microorganisms, Staining Methods, Classification of microorganisms, Study of bacteria, fungi, and viruses and their diseases, Infection and pathogenicity

Module 4: Clinical microbiology: Transport & Examination of specimen in clinical diagnostic laboratory, Quality control, Basic microscopy for clinical microbiology, Antibiotic sensitivity testing, Serological Diagnosis of Microbial Diseases, Molecular methods in clinical microbiology: Applications of PCR, RFLP, Nuclear hybridization methods.

Module 5: General and Systemic Pathology Cell injury, inflammation, and repair, Hemodynamic disorders: edema, thrombosis, embolism, Neoplasia: benign vs malignant tumors, Pathophysiology of common diseases: atherosclerosis, cancer, hepatitis, renal failure, Histopathological techniques and tissue staining

Text Books:

1. D M Vasudevan, Text book of Biochemistry for medical students, 6th edition Jaypee
2. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education

3. *Robbins and Cotran Pathologic Basis of Disease* by Vinay Kumar, Abul Abbas, Jon Aster

Reference Books:

1. Lehninger (2013), Principles of Biochemistry, 6th edition, W H Freeman
2. Mohanty S and Verma A (2013), Practical Clinical Biochemistry, 1st edition, Jaypee
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
5. **Medical Laboratory Science: Theory and Practice** by Ochei and Kolhatkar

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Core- IV (Basic Clinical Science)	Course Code:	BME11008

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	0	0	0	0	0	0	0	0	3	3	3
CO2	2	3	2	1	0	0	0	0	0	0	0	0	3	3	3
CO3	3	2	1	2	2	1	0	0	0	0	0	0	3	3	3
CO4	3	2	1	2	2	1	0	0	0	0	0	0	3	3	3
CO5	3	2	1	2	2	1	0	0	0	0	0	0	3	3	3
CO6	3	2	1	2	2	1	0	0	0	0	0	0	3	3	3
Average	2.8	2.3	1.3	1.6	2	1	0	0	0	0	0	0	3	3	3

Prof. Core- V (Biomedical Signal acquisition & processing)

BME11009	**Prof. Core- V (Biomedical Signal acquisition & processing)**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hours - 60**	3	1	0	4
Pre-requisites/Exposure	12th level Physics, Chemistry, and Mathematics				
Co-requisites	--				

Course Objectives

1. Understand characteristics of some of the most commonly used biomedical signals, including ECG, EEG, EOG, and EMG.
2. Understand choice of filters to remove noise and artifacts from biomedical signals.
3. Apply established engineering methods to analyse ECG signal problems.
4. Apply established engineering methods to analyse neurological signals.
5. Analyse various biomedical signals through advanced techniques.

Couse Outcome

On completion of this course, the students will be able to

CO1. Understand the fundamental techniques & applications of digital signal processing with emphasis on biomedical signals.

CO2. Implement algorithms based on discrete time signals.

CO3. Understand circular and linear convolution and their implementation in DFT and analyze signals.

CO4. Understand efficient computation techniques such as DIT and DIF FFT Algorithms.

CO5:Design FIR filters using windowing techniques and frequency sampling methods, and **develop specialized filters** like FIR differentiators and Hilbert transformers.

CO6. **Design IIR filters** from analog prototypes using impulse invariant and bilinear transformation methods, and **evaluate** Butterworth, Chebyshev, and Elliptic filters for biomedical applications.

Course Description:

This course introduces the fundamentals of Digital Signal Processing (DSP) with a focus on biomedical applications. It covers the nature and origin of bio-signals, various signal types, and noise sources. Students will explore frequency domain analysis using Z-transform, DFT, and FFT, and learn structural realizations of discrete-time systems. The course also delves into the design techniques for FIR and IIR filters, including classical methods and applications in biomedical signal processing.

Course Content

Module I: Introduction to Digital Signal Processing:

Types of signal and systems, Origins of bio-signals: EMG, ECG, EEG, EOG, PCG; Sources of noise, application of DSP in biomedical engineering.

Module II: Frequency Domain Analysis of Discrete Time Signals and Systems:

Z-transform, Z-transform properties, Inverse z-transform, System analysis using Z transform, Discrete Fourier analysis, Discrete-Time Fourier Transform (DTFT), Inverse DTFT. Discrete Fourier Transform (DFT), Inverse DFT. Fast Fourier Transform, Types of FFT, N-point Radix-2 FFT, Inverse FFT.

Module III: Structures of Discrete-Time Systems:

Realization of discrete-time systems, FIR systems: Direct, Cascade, Frequency Sampling and Lattice structures. Structures for IIR systems: Direct, Signal Flow Graphs and Transposed, Cascade, Parallel, Lattice and Lattice-Ladder structures. State space system analysis and structures

Module IV: FIR Filter Design

Symmetric and Anti-symmetric FIR filters, FIR Filter design by window method (Rectangular, Bartlett, Hamming, Hanning, Blackman and Kaiser window), Frequency Sampling method, Optimum approximation of FIR filters, Design of FIR differentiators, Design of Hilbert transformers

Module V: IIR Filter Design

Design of Discrete-time IIR filters from Continuous-time Filters: Filter design by Impulse invariant and bilinear transformation method: Butterworth, Chebyshev and Elliptic approximation Filter, Frequency transformation.

Text Books:

1. Digital Signal Processing – Principles, Algorithms and Applications by J. G. Proakis and D. G. Manolakis, 4th Edition, Pearson
2. Discrete Time Signal Processing by A.V. Oppenheim, R. W. Schafer, & John R. Buck, , 2nd Edition, Prentice Hall, 1999.

Reference Books:

1. Digital Signal Processing: Fundamentals and Applications – Li Tan, Academic Press, Elsevier.
2. Digital Signal Processing – S. Salivahan, A. Vallavraj and C. Gnanapriya, TMH.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Core- V (Biomedical Signal acquisition & processing)	Course Code:	BME11009

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	3	0	0	0	3	0	0	0	0	3	0	3	0	3
CO2	0	3	0	0	0	3	0	0	0	0	3	0	3	0	3
CO3	0	3	0	0	0	3	0	3	0	0	3	0	3	0	3
CO4	0	3	0	0	0	3	0	3	0	0	3	0	3	0	3
CO5	0	3	0	0	0	3	0	3	0	0	3	0	3	0	3
CO6	0	3	0	0	0	3	0	3	0	0	3	0	3	0	3
Average	0	3	0	0	0	3	0	2	0	0	3	0	3	0	3

Prof. Core- VI (Microcontroller and Interfacing)

BME11010	Prof. Core- VI (Microcontroller and Interfacing)	L	T	P	C
Version 1.0	Contact Hours - 60	3	1	0	4
Pre-requisites/Exposure	12th level Physics, Mathematics, Digital Electronics, Computer Architecture				
Co-requisites	Basic electronics				

Course Objective

1. Outline the history of computing devices.
2. Develop programs for microprocessor and microcontrollers.
3. Understand 8051 microcontroller concepts, architecture and programming.

Couse Outcome

On completion of this course, the students will be able to

CO1. Explain the difference between Microprocessors & Microcontrollers, Architecture of 8051 Microcontroller, Interfacing of 8051 to external memory and Instruction set of 8051

CO2. Write 8051 Assembly level programs using 8051 instruction set.

CO3. Explain stack and Input Output Interfacing.

CO4. Write 8051 Assembly language program to generate timings and waveforms using 8051 timers, to send & receive serial data using 8051 serial port and to generate an external interrupt using a switch.

CO5: Explain the Interrupt system, operation of Timers/Counters and Serial port of 8051and interface simple switches, simple LEDs, ADC 0804, LCD and Stepper Motor to 8051 using 8051 I/O ports.

CO6. Study the advanced microcontroller and control the different physical parameters.

.

Course Description:

To make the students understand that Microcontroller is a required course for under-graduate students in the BME program. The purpose of this course is to teach students the fundamentals of microcontroller systems. The student will be able to incorporate these concepts into their electronic designs for other courses where control can be achieved via a microprocessor/controller implementation.

Course Content

Module 1: Introduction of 8051 Microcontroller:

Introduction to Microprocessors and Microcontrollers, basic overview of 8085 Microprocessor architecture and applications, Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.

Module 2: 8051 Instruction Set:

Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions.

Module 3: 8051 Stack, I/O Port Interfacing and Programming:

8051 Stack, Stack and Subroutine instructions. Assembly language program examples on subroutine and involving loops.Interfacing simple switch and LED to I/O ports to switch on/off LED with respect to switch status.

Module 4: 8051 Timers and Serial Port:

8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode- 2 on a port pin. 8051 Serial Communication- Basics of Serial Data Communication, RS- 232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially.

Module 5: 8051 Interrupts and Interfacing Applications:

8051 Interrupts. 8051 Assembly language programming to generate an external interrupt using a switch, 8051 C programming to generate a square waveform on a port pin using a Timer interrupt. Interfacing 8051 to ADC-0804, DAC, LCD and Stepper motor and their 8051 Assembly language interfacing programming.

Reference Books

Text Books

1. "The 8051 Microcontroller and Embedded Systems – using assembly and C", Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006.
2. "The 8051 Microcontroller", Kenneth J. Ayala, 3rd Edition, Thomson/Cengage Learning.

Reference Books

1. "The 8051 Microcontroller Based Embedded Systems", Manish K Patel, McGraw Hill, 2014, ISBN: 978-93-329-0125-4.
2. "Microcontrollers: Architecture, Programming, Interfacing and System Design", Raj Kamal, Pearson Education, 2005.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Core- VI (Microcontroller and Interfacing)	Course Code:	BME11010

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	3	0	0	0	3	0	0	0	0	3	0	3	0	3
CO2	0	3	0	0	0	3	0	0	0	0	3	0	3	0	3
CO3	0	3	0	0	0	3	0	3	0	0	3	0	3	0	3
CO4	0	3	0	0	0	3	0	3	0	0	3	0	3	0	3
CO5	0	3	0	0	0	3	0	3	0	0	3	0	3	0	3
CO6	0	3	0	0	0	3	0	3	0	0	3	0	3	0	3
Average	0	3	0	0	0	3	0	2	0	0	3	0	3	0	3

Prof. Core- VII Biomaterials

BME11011	Prof. Core- VII (Biomaterials)	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	10+2 Level Chemistry, Knowledge of Biology and Physics				
Co-requisites	--				

Course Objectives

The student would be able to learn the characteristics and classification of Biomaterials.

1. Understand polymeric materials, composites, and combinations that could be used as tissue replacement implants.
2. Students should be able to understand how to develop artificial organs using these materials.
3. Instill a fundamental understanding of the properties and applications of biomaterials, both natural and synthetic that are used in contact with biological systems in the area of various tissues and organ replacement.
4. To acquaint students with the interactions between biomaterials and the human body that lead to the failure of devices.
5. This course presents a balanced perspective on the evolving discipline of Biomaterials Science by including information on hard biomaterials and soft biomaterials, orthopedic ideas, cardiovascular concepts, ophthalmologic ideas, and dental issues.
6. Demonstrate in-depth knowledge of the mechanical and biological properties of both natural and synthetic biomaterials used in implant design and artificial tissue or organ making.
7. Describe the role of adsorbed proteins and cells in the tissue response to biomaterials.
8. Appreciate the complex mechanical and biological interactions between biomaterials and biological systems.
9. Gain a solid appreciation for the special significance of the word biomaterial as well as the rapid and exciting evolution and expansion of biomaterials science and its applications in health care.

Couse Outcome

On completion of this course, the students will be able to

CO1. Analyze different types of Biomaterials and their classification and apply the concept of nanotechnology towards biomaterials use.

CO2. Identify significant gaps required to overcome challenges and further development in metallic and ceramic materials.

CO3. Identify significant gaps required to overcome challenges and further development in polymeric materials.

CO4:Analyze the interaction mechanisms between cells and biomaterials, including wound healing, foreign body response, and pathological effects of implants.

CO5. Understand the testing standards applied for biomaterials.

CO6 Identify and explain the application of biomaterials in soft and hard tissue replacements, including their roles in dental implants, intraocular lenses, and metallic hip joints.

Course Content

Module 1: Biomaterial – Classification of biomaterials – Natural and synthetic materials - Properties of biomaterials - Bulk and surface properties – Biocompatibility – Assessment of biocompatibility of biomaterials. Various classes of biomaterials - Metals, Ceramics, Polymers and Composites – Implantable biomaterials – Temporary or permanent implants – Bio-degradable and non-biodegradable materials.

Module 2: Cell-biomaterial interactions – Interactions between human tissue and biomaterials - Wound healing – Foreign-Body response - Pathological response to implants.

Module 3: Blood-material interactions – Evaluation of blood material interactions – Hemocompatibility – *In Vivo* testing and histocompatibility assessment.

Module 4: Applications of biomaterials in medicine - Soft and hard tissue replacements - Dental implants - Intraocular lens – Metallic hip joint.

Text Books:

1. Buddy D. Ratner. Biomaterials science: an introduction to materials in medicine.
2. Frederick H. Silver, David L. Christiansen-Biomaterials Science and Biocompatibility-Springer-Verlag New York (1999)

Reference Books:

1. Pignatello R. - Advances in Biomaterials Science and Biomedical Applications
2. Qing Li, Yiu-Wing Mai (eds.) - Biomaterials for Implants and Scaffolds-Springer-Verlag Berlin Heidelberg (2017)

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Core- VII (Biomaterials)	Course Code:	BME11011

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	3	0	0	0	3	0	0	0	0	3	0	3	0	3
CO2	0	3	0	0	0	3	0	0	0	0	3	0	3	0	3
CO3	0	3	0	0	0	3	0	3	0	0	3	0	3	0	3
CO4	0	3	0	0	0	3	0	3	0	0	3	0	3	0	3
CO5	0	3	0	0	0	3	0	3	0	0	3	0	3	0	3
CO6	0	3	0	0	0	3	0	3	0	0	3	0	3	0	3
Average	0	3	0	0	0	3	0	2	0	0	3	0	3	0	3

Prof. Core- IX Medical Imaging

BME11012	**Prof. Core- XI (Medical Imaging)**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hours - 45**	3	0	0	3
Pre-requisites/Exposure	12th level Physics, Chemistry, and Mathematics				
Co-requisites	--				

Course Objectives

By the end of this course, students will be able to:

1. Understand the physical principles and instrumentation behind various medical imaging modalities.
2. Explain the design, working, and applications of X-ray, CT, MRI, PET, SPECT, and ultrasound systems.
3. Analyze image acquisition techniques including contrast use, image processing, and reconstruction.

4. Describe radiation biology and safety protocols in medical imaging.
5. Compare and evaluate different imaging techniques based on their resolution, modality-specific advantages, and clinical uses.
6. Understand emerging technologies such as functional MRI, electron tomography, and elastography.

Couse Outcome

On completion of this course, the students will be able to

CO1. Advanced and integrated understanding of the applications of physical processes to the diagnosis and treatment of disease, including an understanding of contemporary developments in professional practice.

CO2:Compare advanced tomographic methods such as EBT, SSCT, MSCT, μCT, and HRCT, and analyze the principles and advantages of 3D image reconstruction.

CO3. Advanced understanding of the origins of radiation and its interactions with matter pertaining to the production and use of ionizing radiation, with particular regard to the protection of people and environments.

CO4. Develop an understanding of the different modalities in Radiology and recognize the images of each modality.

CO5.Illustrate and apply the principles of medical ultrasonography and endoscopy, including imaging modes (A-scan, B-scan, M-mode), echocardiography, Doppler techniques, VVI, and elastography.

CO6. Describe the differences between the modalities, the method of imaging and safety precautions

Course Description

This course introduces fundamental principles and technologies used in medical imaging, covering X-ray radiography, computed tomography, MRI, PET, SPECT, ultrasonography, and endoscopy. It emphasizes instrumentation, image acquisition, contrast mechanisms, and safety considerations. The course also explores advanced imaging methods including

functional imaging, elastography, and tomography-based 3D reconstructions used in modern diagnostics

Course Content

Unit 1: Radiography and X-ray based Computed Tomography: Basic principle; Equipment: source, detector, contrast agents; Backscatter X-ray; Fluoroscopy: Basic principles and equipments, X-ray image intensifier; Rotational Angiography; Mammography; Dual-energy X-ray absorptiometry (DEXA). X-ray image processing; Radiobiology and Radiation Safety: Biological effects of Radiation; Radiation dose: effects of time, distance and shielding

Unit 2: Tomographic techniques: Basic principle of X-ray based computed tomogrpahy; Equipment; Contrast agents; special procedures: Electron beam tomography (EBT); Spiral computed tomography: principles and advantages over conventional technique. single-slice spiral computed tomography (SSCT), multi-slice spiral computed tomography (MSCT). X-ray microtomography (μCT) and High Resolution computed tomography (HRCT): principles and advantages. Three-dimensional image reconstruction of CT scan images.

Unit 3: Magnetic Resonance Imaging (MRI): Nuclear Magnetic Resonance (NMR); Nuclear precession; effect of external magnetic field on magnetic moments, Equilibrium magnetization significance of Radio frequency (RF) pulse, Resonance and larmor frequency. MRI equipments. T1 and T2 Relaxation. Different MRI methods; fMRI: BOLD

Unit 4: PET and SPECT: Positron emission tomography (PET), PET-CT and PET-MRI; Single-photon emission computed tomography (SPECT), SPECT/CT; Electrical impedance tomography (EIT): a-EIT, f-EIT, MF-EIT; Electron tomography (ET); Magnetic particle imaging (MPI). Magnetic resonance elastography.

Unit 5: Medical ultrasonography and endoscopy: Basic principles; Modes of ultrasonography: A-scan B-scan M-mode imaging and echocardiography; Use of Doppler techniques in ultrasound. Velocity vector imaging (VVI). Ultrasound elastography.

Text Book(s):

1. K. Kirk Shung, Michael Smith, Benjamin M.W. Tsui; Principles of Medical Imaging; Academic

Press; 1992.
2. Ed: Jacob Buetel, Harold L. Kundel, Richard L. van Metter; Handbook of Medical Imaging, Volume 1: Physics and Psychophysics; SPIE; 2000.

Reference Book(s):

1. Chris Guy, Dominic Ffytche; An introduction to the principles of medical imaging; Imperial College Press; Distributed by World Scientific Pub; 2005.
2. R. Khandpur; Biomedical Instrumentation: Technology and Applications; McGraw-Hill Professional; 2004.
3. John G. Webster; Medical Instrumentation Application and Design; 4th Edition; 2009.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: Prof. Core- XI (Medical Imaging) Course Code: BME11012

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	3	0	0	0	3	0	0	0	0	3	0	3	3	3
CO2	0	3	0	0	0	3	0	0	0	0	3	0	3	3	3
CO3	0	3	0	0	0	3	0	3	0	0	3	0	3	3	3
CO4	0	3	0	0	0	3	0	3	0	0	3	0	3	3	3
CO5	0	3	0	0	0	3	0	3	0	0	3	0	3	3	3
CO6	0	3	0	0	0	3	0	0	0	0	3	0	3	3	3
Average	0	3	0	0	0	3	0	3	0	0	3	0	3	3	3

Human Values and Professional Ethics

PSG11021	Human Values and Professional Ethics	L	T	P	C

Version 1.0	**Contact Hours - 30**	2	0	0	2
Pre-requisites/Exposure	12th level Physics, Chemistry, and Mathematics				
Co-requisites	--				

Course Objective

1. To enable the students to generate an awareness on Engineering Ethics and Human Values.
2. To instill Moral and Social Values into the students mind.
3. To realize the social responsibility as an engineer.
4. To appreciate Loyalty and to be aware of the rights of others.

Couse Outcome

On completion of this course, the students will be able to

CO1:Demonstrate an understanding of core human values such as integrity, respect, humility, and self-awareness.

CO2: practice self-assessment and life-goal setting for personal growth.

CO3:Analyze the concept of harmony in the individual, family, society, and nature,

CO4: explain responsibilities in transitioning from school to college and adapting to diverse cultural and academic environments.

CO5: Able to discuss the ethical issues related to engineering responsibilities.

CO6:Examine ethical concerns in industry and global professional practices, including safety, confidentiality, whistleblowing, and environmental responsibility, and assess emerging issues in e-professionalism.

Course Description

Human values and professional ethics are complementary to each other. Whereas human values convey personal conviction, ethics describe the accepted principles and standards of conduct about moral duties and virtues as applied to an organization.

Course Content

Module I: Introduction to Human Values: Character, Integrity, Credibility, Mutual Respect, Dedication, Perseverance, Humility and Perception. Self-Assessment & Analysis, Setting Life Goals, Consciousness and Self-Transformation. Team Work, Conflict Resolution, Influencing and Winning People, Anger Management, Forgiveness and Peace, Morality, Conscience. Yoga and Spirituality

Module II: Harmony and Life Long Learning: Harmony in human being, Nature and Existence. Harmony in family and society –Responsibilities towards society, Respecting teachers. Transition from School to College - Freedom & Responsibilities, Respecting Cultural Diversity, Learning beyond the Classrooms, Independent study and research

Module III: Introduction to Professional Ethics: Work Ethics, Engineering Ethics, Moral Dilemma, Moral Development Theories, Ethical Theories- Kantinism, Utilitarianism, etc , Case Studies for Choice of the theory, Code of Ethics

Module IV: Individual to Global Issues: Industrial Standards, A Balanced Outlook on Law, Safety, Responsibility, Rights, Confidentiality, Conflict of Interest, Occupational Crime, Whistle Blowing, Environmental Ethics, Business Conduct in MNC, E-Professionalism (IPR, Internet Ethics & Privacy issues)

Text Books

1. Shetty, Foundation Course in Human Values and Professional Ethics [R.R. Gaur, R. Sangal, G.P. Bagaria]

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Human Values and Professional Ethics	Course Code:	PSG11021

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	0	0	0	3	0	0	0	0	3	0	0	0	3
CO2	0	0	0	0	0	3	0	0	0	0	3	0	0	0	3
CO3	0	0	0	0	0	3	0	0	0	0	3	0	0	0	3
CO4	0	0	0	0	0	3	0	3	0	0	3	0	0	0	3
CO5	0	0	0	0	0	3	0	3	0	0	3	0	0	0	3
CO6	0	0	0	0	0	3	0	3	0	0	3	0	0	0	3
Average	0	0	0	0	0	3	0	1.5	0	0	3	0	0	0	3

Prof. Core- V Lab (Biomedical Signal Processing Lab)

BME12013	**Prof. Core- V Lab (Biomedical Signal Processing Lab)**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hours - 30**	2	0	0	1
Pre-requisites/Exposure	Knowledge in Digital Electronics				
Co-requisites	--				

Course Objectives

1. To perform primary signal processing operations such as Linear Convolution, Circular Convolution, Auto Correlation, Cross Correlation and Frequency analysis in MATLAB.
2. To implement FIR and IIR filters in MATLAB and DSP Processor
3. To study the architecture of DSP processor

To design a DSP system to demonstrate the Multi-rate and Adaptive signal processing concepts

Couse Outcome

On completion of this course, the students will be able to

CO1. Carryout basic signal processing operations.

CO2. Demonstrate their abilities towards MATLAB-based implementation of various DSP systems.

CO3. Analyze the architecture of a DSP Processor.

CO4. Design and Implement the FIR and IIR Filters in DSP Processor for performing filtering operation over real-time signals.

CO5. Design a DSP system for various applications of DSP.

CO6:Demonstrate proficiency in real-time DSP hardware by developing and porting simple programs using Code Composer Studio (CCS) and the TI 6713 DSP kit.

List of experiments

1. Generation of different types of waveform using MATLAB.
2. Conversion of continuous time signals to discrete sequence/signals.
3. Generation of an arbitrary discrete sequence
4. Perform linear convolution of two sequences without using MATLAB “conv” command.
5. Perform cross correlation of two sequences without using MATLAB “corr” command.
6. Plot pole-zero for a given sequence and systems.
7. Perform Discrete Fourier Transform using Matrix Multiplication
8. Implementation of circular convolution of the two given sequences using DFT based approach.
9. Perform linear convolution of a finite length sequence with an infinite length sequence using overlap add method

h[n]={1,1,1} and x[n]={3,-1,0,1,3,2,0,1,2,1}

10. Design low pass, high pass and band pass IIR Butterworth direct form -1 digital filter using the Filter-builder command.

11. Design low pass, high pass and band pass IIR Butterworth direct form -1 digital filter using the FDA tool.

12. Design low pass, high pass and band pass IIR Butterworth direct form -1 digital filter using MATLAB.

13. Write a Matlab code to design an FIR filter using window method

14. Design a 25 tap low-pass FIR filter with cut off frequency 0.5pi radian using window method.

15. Design a 25 tap low-pass FIR filter with cut off frequency 0.5pi radian using window method and plot the responses using fvtool.

16. Familiarization with the CC Studio and TI 6713 DSP.

17. Display a message ("ADAMAS UNIVERSITY") in the monitor by writing a program in CC Studio environment and porting it to TI 6713 DSP.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: Prof. Core- V Lab (Biomedical Signal Processing Lab) Course Code: BME12013

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	0	0	0	3	0	0	0	0	3	0	0	0	3
CO2	0	0	0	0	0	3	0	0	0	0	3	0	0	0	3
CO3	0	0	0	0	0	3	0	0	0	0	3	0	0	0	3
CO4	0	0	0	0	0	3	0	3	0	0	3	0	0	0	3

CO5	0	0	0	0	0	3	0	3	0	0	3	0	0	0	3
CO6	0	0	0	0	0	3	0	3	0	0	3	0	0	0	3
Average	0	0	0	0	0	3	0	1.5	0	0	3	0	0	0	3

Prof. Core- VI Lab (Microcontroller and Interfacing)

BME12014	**Prof. Core- VI Lab (Microcontroller and Interfacing Lab)**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hours - 30**	0	0	2	1
Pre-requisites/Exposure	Knowledge in Digital Electronics				
Co-requisites	--				

Course Objectives

1. To know the operations of microcontrollers through performing experiments.
2. To learn machine label language programming and interfacing techniques with peripherals.
3. To learn different application part of microcontroller.

Couse Outcome

On completion of this course, the students will be able to

CO1. **Find** the Assembly language programs of 8051.
CO2. **Illustrate** the real time analysis of 8051 through programs.
CO3. **Find** how to interface external devices with microprocessor.
CO4. **Find** how to interface external devices with microcontroller.
CO5. **Design** project based on microcontroller knowledge.
CO6:Analyze and troubleshoot hardware-software integration issues in real-time embedded systems using microprocessor/microcontroller interfacing techniques.

List of experiments

1. Familiarization with 8051 controller Kit.
2. Add two 8 bit numbers and stored at consecutive memory location.
3. Subtract two 8 bit numbers and stored at consecutive memory location.
4. To multiply two 8 bit numbers and stored at consecutive memory location.
5. To divide two 8 bit numbers and stored at consecutive memory location.
6. To find the largest element in an array.
7. To find the smallest element in an array.
8. To sort the given number in ascending order
9. To sort the given number in descending order
10. To convert decimal to hexadecimal.
11. To convert hexadecimal to decimal.
12. BCD addition.
13. BCD subtraction.
14. Copying a block of memory
15. Shifting a block of memory
16. Interfacing Keyboard and Multi-digit Display with multiplexing using 8255
17. Interfacing Stepper Motor.
18. Interfacing ADC and DAC.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Core- VI Lab (Microcontroller and Interfacing Lab)	Course Code:	BME12014

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	0	0	0	3	0	0	0	0	3	0	0	0	3
CO2	0	0	0	0	0	3	0	0	0	0	3	0	0	0	3

CO3	0	0	0	0	0	3	0	3	0	0	3	0	0	0	3
CO4	0	0	0	0	0	3	0	3	0	0	3	0	0	0	3
CO5	0	0	0	0	0	3	0	3	0	0	3	0	0	0	3
CO6	0	0	0	0	0	3	0	0	0	0	3	0	0	0	3
Average	0	0	0	0	0	3	0	1.5	0	0	3	0	0	0	3

Basic Clinical Science Lab

BME12015	**Prof. Core- VI Lab (Basic Clinical Science Lab)**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hours - 30**	0	0	2	1
Pre-requisites/Exposure	Knowledge of biology. Chemistry				
Co-requisites	--				

Course Objectives

1. To provide hands-on training in basic biochemical, microbiological, and hematological lab techniques.

2. To develop skills in buffer preparation, pH measurement, and biomolecule estimation.

3. To understand aseptic techniques and microbial culture and staining methods.

4. To perform routine blood tests including cell counts, hemoglobin estimation, and blood grouping.

5. To identify microorganisms and examine histological slides for pathological changes.

Couse Outcome

On completion of this course, the students will be able to

CO1: Demonstrate proficiency in preparing buffer solutions and measuring pH for biochemical applications.

CO2: Perform biochemical estimations relevant to clinical diagnostics.

CO3: Apply aseptic techniques and microbial culture methods to isolate and study microorganisms.

CO4: Perform Gram staining and identify common bacterial species under the microscope.

CO5: Conduct haematological tests and interpret blood cell counts for diagnostic purposes.

CO6: Examine histological slides to identify pathological changes in tissues.

Course Description:

This lab course introduces students to essential biomedical laboratory techniques. It covers biochemical estimations, microbial culture and identification, and hematological procedures. Students gain practical experience in preparing buffers, staining cells and microorganisms, performing blood tests, and observing pathological tissue slides. The course equips students with foundational skills needed in clinical and research laboratories.

List of experiments

1. **Preparation of Buffers and pH Measurement**
2. **Estimation of Blood Glucose (Glucose Oxidase Method)**
3. **Protein Estimation by Biuret or Lowry's Method**
4. **Aseptic Techniques and Media Preparation**
5. **Gram Staining and Bacterial Morphology**
6. **Culture Techniques: Streak Plate and Pour Plate**
7. **Identification of Common Microorganisms (E. coli, Staphylococcus, etc.)**
8. **Hemoglobin Estimation**
9. **Total Leukocyte Count and Differential Count**
10. **RBC and Platelet Count using Hemocytometer**
11. **Blood Group Determination (ABO and Rh typing)**
12. **Preparation and Staining of Blood Smear (Leishman's stain)**
13. **Histological Slide Observation of Pathological Tissues (prepared slides)**

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	**50**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: Prof. Core- VI Lab (Basic clinical Science Lab) Course Code: BME12015

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	1	0	0	0	0	0	0	3	3	3
CO2	3	2	2	3	3	1	0	0	0	0	0	0	3	3	3
CO3	3	2	2	3	3	1	0	0	0	0	0	0	3	3	3
CO4	3	2	2	3	3	1	0	0	0	0	0	0	3	3	3
CO5	3	2	2	3	3	1	0	0	0	0	0	0	3	3	3
CO6	3	2	2	3	3	1	0	0	0	0	0	0	3	3	3
Average	3	2	2	3	3	1	0	0	0	0	0	0	3	3	3

V SEMESTER

BME11016	Prof. Core- VIII (Biomechanics)	L	T	P	C
Version 1.0	**Contact Hours – 60**	3	1	0	4
Pre-requisites/Exposure	Fundamentals of Mechanics, anatomy, physiology				
Co-requisites	--				

Course Objectives:

1. To describe the fundamental of biomechanics.
2. To Study the deformability, strength, viscoelasticity of bone and flexible tissues, modes of loading and failure.

3. To describe the types and mechanics of skeletal joints.
4. To describe movement precisely, using well defined terms (kinematics) and also to consider the role of force in movement (kinetics).
5. To teach students the unique features of biological flows, especially constitutive laws and boundaries.
6. To consider the mechanics of orthopedic implants and joint replacement, artificial heart valve, mechanical
properties of cardiovascular and respiratory mechanics

Course Outcomes

On completion of this course, the students will be able to

CO1. Apply foundational principles of engineering mechanics to analyze the equilibrium, kinematics, and dynamics of particles and rigid bodies, including energy and momentum concepts.

CO2. Explain the mechanical behavior of hard tissues, including bone structure, viscoelasticity, and fatigue, using appropriate models such as Maxwell and Voight.

CO3. Characterize and model soft biological tissues like cartilage, tendons, ligaments, and muscles by integrating knowledge of their structure, function, and dynamic responses.

CO4. Analyze human joint mechanics through biomechanical modeling and assess motion, force distribution, and stress in various joints during movement and gait.

CO5. Evaluate cardiovascular fluid mechanics, including blood flow properties and arterial dynamics, using theoretical models and experimental techniques.

CO6. Integrate interdisciplinary concepts from engineering and biology to solve real-world biomechanical problems involving tissues, joints, and fluid systems in the human body.

Course Description

This is a first level course to learn the fundamental of biomechanics. This study covers the types and mechanics of skeletal joints, deformability, strength, viscoelasticity of bone and flexible tissues. Students will be able to learn detailed understanding of the design requirements of medical implants based on the human anatomy and biological responses to biomaterials. Students will be expected to be familiar with engineering problems related to practical field.

Course Content

Module 1: Engineering Mechanics: Free-body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations, collisions. Strength of materials.

Module 2: Hard Tissues: Definition of Stress and Strain; Deformation Mechanics. Bone structure & composition, mechanical properties of bone, cortical and cancellous bones, viscoelastic properties, Maxwell & Voight models – anisotropy, Fatigue Analysis

Module 3: Soft Tissues: Structure, functions, material properties and modelling of Soft Tissues: Cartilage, Tendon, Ligament, Muscle - Hodgkin-Huxley Model.

Module 4: Human Joints and Movements: Skeletal joints, forces and stresses in human joints, types of joints, biomechanical analysis joints, parameterization and analysis in Gait.

Module 5: Biofluid mechanics: Flow properties of blood, Dynamics of fluid flow in the intact human cardiovascular system - modelling and experimental approaches, Pulse wave velocities in arteries, Measurement/Estimation of in-vivo elasticity of blood vessels

Text Book(s):

1. Subrata Pal, Text book of Biomechanics, Viva education private limited, 2009.

Reference Book(s):

1. Y.C.Fung, Biomechanics: Mechanical properties in living tissues, Springer Verlag, New York, 1981.
2. Susan J.Hall, Basic Biomechanics; 5th Edition, McGraw-Hill Publishing Co, Newyork, 2007.
3. C.R Ethier and C.A.Simmons, Biomechanics from cells to organisms, Cambridge University Press, 2007.
4. D.Dawson and Right, Introduction to Bio-mechanics of joints and joint replacement, Mechanical Engineering publications Ltd. 1989.
5. Basic Biomechanics of the Musculoskeletal System; Margareta Nordin and Victor H Frankel; 3rd Edition; Wolters Kluwer.; 2011.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Core- VIII (Biomechanics)	Course Code:	BME11016

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	0	0	0	0	0	0	0	0	0	0	3
CO2	3	3	3	3	0	0	0	0	0	0	0	0	0	0	3
CO3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	3
CO4	3	3	3	3	0	0	0	0	0	0	0	0	0	0	3
CO5	3	3	3	3	0	0	0	0	0	0	0	0	0	0	3
CO6	3	3	3	3	0	0	0	0	0	0	0	0	0	0	3
Average	3	3	3	3	0	0	0	0	0	0	0	0	0	0	3

Troubleshooting and Quality Control of Medical Devices

BME 11017	Troubleshooting and Quality Control of Medical Devices	L	T	P	C
Version 1.0	**Contact Hours – 45**	3	0	0	3
Pre-requisites/Exposure	Basic Knowledge of 12th Physics, Chemistry, Math and understanding of common medical devices.				
Co-requisites	--				

Course Objectives

1. Create a sound understanding of the working conduction of a biomedical device.
2. Create a sense of ordinary working and abnormal behaviour of a medical device.
3. To provide knowledge to students to enable them to troubleshoot the various equipment's used in hospitals.
4. Provide a working protocol for quality control assessment.
5. Prepare the students for handling situation inside a hospital working condition.

Course Outcomes

On completion of this course, the students will be able to

CO1. Demonstrate proficiency in testing and analyzing electrical equipment, including transformers, circuit breakers, earthing systems, and control panels, using standard procedures and instruments.

CO2. Perform diagnostics and testing on electronic components and circuits, such as PCBs, sensors, and power supplies, while adhering to safe electrical practices and regulatory standards.

CO3. Operate, test, and maintain surgical equipment effectively, understanding their functionality and applying preventive maintenance techniques to ensure clinical readiness.

CO4. Troubleshoot and manage diagnostic and life-support devices (e.g., ECG machines, incubators, infusion pumps), maintaining compliance with maintenance contracts and quality

standards.

CO5. Apply principles of life cycle cost analysis and decision-making strategies to manage medical equipment efficiently from procurement through disposal, optimizing performance and cost-effectiveness.

CO6. Implement reliability assurance methods such as FMEA, MTBF, and regulatory compliance (e.g., ISO, FDA), and utilize computerized systems to enhance the safety and reliability of medical devices.

Course Description:

This course provides practical knowledge and skills in testing, troubleshooting, and maintenance of electrical, electronic, and biomedical equipment. It covers testing of AC/DC power supplies, circuit breakers, transformers, relays, and protective devices. Students will learn to troubleshoot PCBs, calibrate sensors, and test surgical and diagnostic equipment such as ventilators, patient monitors, and X-ray machines. The course also emphasizes safety standards, quality assurance, vendor coordination, and the life cycle management of medical equipment, including cost analysis and service optimization.

Module 1: Testing of Electrical Equipments AC, DC power supply, Grounding, shielding, Guarding, insulation testing, insulation resistance measurement, Types of Circuit Breakers, Rating – Testing of circuit breakers –Transformer testing- Earthing –Earth wires - Earthing of appliances –contactor, relay testing– CT and PT, Panel wiring- Megger-Testing equipment and instruments.

Module 2: Testing of Electronic Components Troubleshooting of PCB boards, Calibration of analog and digital sensor probe, Display interface, DC Power supply design, testing, Safe electrical practice, Cables and standard, Fuse.

Module 3: Testing of Surgical Equipment Functions and operating procedure-Testing and maintenance of Heart lung machine, surgical lights, ventilator, patient monitor, anesthesia machine, dialyzer, surgical tools.

Module 4: Troubleshooting of Equipments X-ray machines, Troubleshooting of ECG recorders, incubator, baby warmer, infusion pumps, annual maintenance, contract requirements, vendor services, quality and safety standards.

Module 5: Life Cycle Management of Medical Equipment Cost of the medical equipment, maintenance cost, replacement analysis, managing equipment service, decision making, extracting optimal benefit from medical equipment over its life cycle.

Module 6: Reliability in medical devices: Need for reliability, Tools for reliability assurance, MTBF, MTTR, FMEA, Fault tree analysis, Markov method, cause failure analysis. Human errors in healthcare systems, human factors approach to reduce error, Quality assurance through regulatory compliance: ISO: 9000, FDA, IEEE, ASTM, UL, CE. Computerized Maintenance management system for medical equipment.

Text Books:

1. B.S. Dhillon, "Medical Device Reliability and Associated Areas", CRC Press, UK, 2000.
2. Joseph. J Carr, John M Brown, Introduction to Biomedical Equipment Technology, John Wiley& Sons, New York,4thedition, 2008.
3. Keith Willson, Keith Ison, Slavik Tabakov, "Medical equipment management", CRC Press, UK, 2014.

Reference Book:

1. Jenny Dooley,John Lehnert Virginia Evans, "Career Paths: Medical Equipment Repair", Express Publishing, UK,2018
2. Shakti Chatterjee, Aubert Miller, "Biomedical Instrumentation systems", Cengage Learning Technology & Engineering, 2010.
3. David Herres, "Troubleshooting and Repairing Commercial Electrical Equipment", McGraw Hill Professional edition, 2013.
4. R. S. Khandpur, "Troubleshooting Electronic Equipment" 1st Edition, McGraw Hill, 2007.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Attendance	Class Assessment	End Term
Weightage (%)	20	10	30	40

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Troubleshooting and Quality Control of Medical Devices	Course Code:	**BME11017**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	0	0	2	0	0	3	0	0	0	0	0	0
CO2	3	2	3	0	0	2	0	0	3	0	0	0	0	0	0
CO3	3	2	3	0	0	2	0	0	3	0	0	0	0	0	0
CO4	3	2	3	0	0	2	0	0	3	0	0	2	0	0	0
CO5	3	2	3	0	0	2	0	0	3	0	0	2	0	0	0
CO6	3	2	3	0	0	2	0	0	3	0	0	2	0	0	0
Average	3	2	3	0	0	2	0	0	3	0	0	1	0	0	0

Biomedical Instrumentation – I

BME11018	Prof. Core- X (Biomedical Instrumentation – I)	L	T	P	C
Version 1.0	**Contact Hours – 45**	3	0	0	3
Pre-requisites/Exposure	Knowledge of analog & digital electronics				
Co-requisites	--				

Course Objectives:

- To understand the components and challenges of the man-instrument system.
- To study the origin and types of bioelectric signals and their detection using electrodes.
- To design and analyze basic instrumentation systems for biosignal acquisition.
- To learn the principles and functions of various diagnostic and therapeutic biomedical devices.
- To understand the operation of patient monitoring systems and ensure safety in medical instrumentation.

Course Outcomes

On completion of this course, the students will be able to

CO1. Explain the structure and function of man-instrument systems and interpret the challenges involved in measuring physiological signals from living systems.

CO2. Identify the sources and characteristics of bioelectric signals and classify biopotential electrodes based on configuration and biomedical application.

CO3. Design and analyze bio-signal instrumentation systems, including bio-potential amplifiers, filters, and noise reduction methods, using signal processing principles.

CO4. Demonstrate an understanding of diagnostic and therapeutic biomedical devices, explaining their operating principles and measurement techniques for various physiological parameters.

CO5. Assess and operate patient monitoring systems such as cardiac and respiratory monitors, and describe equipment used in critical care environments like ICCUs and catheterization labs.

CO6. Apply safety standards and protocols related to medical equipment, emphasizing patient safety, diathermy procedures, and best practices in clinical instrumentation settings.

Course Description:

This course introduces the principles and applications of biomedical instrumentation used to monitor, diagnose, and treat physiological conditions. It covers bioelectric signals, electrode systems, and biopotential amplifiers. Students learn the working principles of diagnostic and therapeutic devices such as ECG, EEG, pacemakers, defibrillators, and audiometers. The course also explores patient monitoring systems, intensive care instrumentation, and safety standards in medical equipment usage.

Course Content

Module 1: Introduction to Biomedical Instrumentation:, Introduction to the man-instrument system, Components of the man instrument system, Physiological Systems of the body, Problems encountered in measuring a living system, Origin of bioelectric signals, Basis of bioelectric signal characteristics.

Module 2: Sources of Bioelectric potentials, Electrocardiogram, Electroencephalogram, Electromyogram, Biopotential electrodes: Electrode-electrolyte interface, Unipolar and Bipolar configuration, Classification of electrodes used in biomedical applications.

Module 3: Basic Instrumentation system for Bio signals: Design of a differential Bio potential Amplifier, Instrumentation amplifier; Transfer function representation; Filters; Frequency response and noise reduction.

Module 4: Diagnostic and Therapeutic devices- Principle and working of Photo-plethysmography, Pure tone and Speech tone Audiometer, Working principles and types of Defibrillator. Pacemaker, Blood pressure measurement-Blood flow measurement-Heart sound measurement, Spirometry-Measurement of functional residual volume-CO2 analyzer and Oxygen analyzer.

Module 5: Patient monitoring system and Medical Equipment Safety, Cardiac monitor, Bedside monitors, Central monitors, Heartrate meter, Pulse rate meter, Measurement of respiration rate, Holter monitor and Cardiac stress test, Catheterization Laboratory Instrumentation, Organization and Equipment used in ICCU and ITU., Basics of Diathermy: Surgical Diathermy, Patient safety and medical equipment safety

Text Books:

1 Khandpur R.S., Hand book of Biomedical Instrumentation, TMH, 2003.
2 Tompkins, Biomedical Digital Signal Processing.
Leslie Cromwell**,** Fred J**.** Weibell**,** Pub**:** Erich A**.** Pfeiffer**.** Biomedical Instrumentation and Measurements**.**

Reference Books:

1 Carr & Brown, Introduction to Biomedical Equipment, Pearson Education, 2005.
2 Webester J.G., Medical Instrumentation, 3rd Edition, John Wiley,1997
3 Bio medical Engineering System By Manfred Clyner, John H. Milsum (McGrawHill)
4 Biomedical Signal Analysis – A Case Study Approach By Rangaray M. Rangayyan, (John Wiley and SonsInc)
5 Christensen's physics of Diagnostic Radiology by Thomas S. Curry,JumerE. Dowdey, Robert C. Murry.
6 Medical Instrumentation Haughton by John C**.** Webster (Mifflis Co**.** BostonUSA).
7 Bio-Medical Instrumentation – Dr. M. Arumugam, Anuradha Agencies, 2005

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term

Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Core- X (Biomedical Instrumentation – I)	Course Code:	BME11018

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	0	0	0	0	0	0	0	0	3	3	3
CO2	3	3	3	3	0	0	0	0	0	0	0	0	3	3	3
CO3	3	3	3	3	0	0	0	0	0	0	0	0	3	3	3
CO4	3	3	3	3	0	0	0	0	0	0	0	0	3	3	3
CO5	3	3	3	3	0	0	0	0	0	0	0	0	3	3	3
CO6	3	3	3	3	0	0	0	0	0	0	0	0	3	3	3
Average	3	3	3	3	0	0	0	0	0	0	0	0	3	3	3

Modelling and Simulations of Biomedical Systems

BME11019	Prof. Elective- I (Modelling and simulation of biomedical systems)	L	T	P	C
Version 1.0	**Contact Hours – 45**	3	0	0	3
Pre-requisites/Exposure	Anatomy, physiology, mathematics, basic electronics, basic electical				

Co-requisites	--

Course Objective

1. To describe general methods and principles for modelling and simulating a system.
2. To apply these principles when designing mathematical models for realistic systems.
3. To implement and use computer-based modelling and simulation for studying relevant problems.
4. To apply these methods and principles for modelling of systems and processes relevant for diagnostics, treatment and as well as different physiological processes.
5. To assess the pertinency and usability for diverse models and simulation procedures.

Course Outcomes

On completion of this course, the students will be able to

CO1. Describe various mathematical modeling techniques and classify model types with respect to physiological systems, including linearization methods and system time-dependence.

CO2. Apply equivalent circuit models to analyze membrane electrophysiology and bioelectric signal generation, using canonical models like the Hodgkin-Huxley neuron and muscle contraction systems.

CO3. Design and simulate biophysical models that represent motor unit activity, strength-duration responses, and electromyographic (EMG) signals with appropriate analytical tools.

CO4. Interpret and construct physiological models of circulatory systems, including blood vessel dynamics and coronary circulation, based on electrical analog principles.

CO5. Model solute and fluid transport phenomena in renal and immune systems using structured approaches such as counter-current mechanisms and linearized immune response equations.

CO6. Evaluate model behavior and system stability in physiological contexts through simulation, signal analysis, and application of stability criteria in biomedical systems.

Course Description

The purpose of the course is to introduce and apply methods of general interest in modelling and simulations. The course aims at giving a mix between theory and hands on practice in relevant application areas. The focus is to study methods and applications that are of relevance in biomedical engineering within diagnostic and therapeutic applications as well as for physiological processes.

Course Content

Module 1: Approaches to modelling - The technique of mathematical modelling, classification of models, characteristics of models. Purpose of physiological modelling and signal analysis, linearization of nonlinear models. Time invariant and time varying systems for physiological modelling.

Module 2: Equivalent circuit model, Electromotive, resistive and capacitive properties of cell membrane change in membrane potential with distance, voltage clamp experiment and Hodgkin and Huxley's model of action potential, the voltage dependent membrane constant and simulation of the model, model for strength-duration curve, model of the whole neuron. Huxley model of isotonic muscle contraction, modelling of EMG, motor unit firing: amplitude measurement, motor unit & frequency analysis.

Module 3: Physiological modelling, Electrical analog of blood vessels, model of systematic blood flow, model of coronary circulation, transfer of solutes between physiological compartments by fluid flow, counter current model of urine formation, model of Henle's loop, and Linearized model of the immune response: Germ, Plasma cell, Antibody, systemequation and stability criteria.

Text Books:	
1	Endarle, Blanchard & Bronzino, Introduction to Biomedical Engg. , Academic press..
2	Suresh. R. Devasahayam, Signals & Systems in Biomedical Engineering, Kluwer Academic/ Plenum Publishers.
3	V.Z. Marmarelis, Advanced methods of physiological modeling, Plenum Press
Reference Books:	
1	J. Candy, Signal Processing: The Model Based approach, Mc. Graw Hill.

2	L.Stark, Neurological Control System, Plenum Press
3	R.B. Stein, Nerve and Muscle, Plenum Press.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Elective- V (Modelling and simulation of biomedical systems)	Course Code:	BME11019

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	0	3	0	0	0	3	0	0	0	0	0	0	3
CO2	3	3	0	3	0	0	0	3	0	0	0	3	0	0	3
CO3	3	3	0	3	0	0	0	3	0	0	0	3	0	0	3
CO4	3	3	0	3	0	0	0	3	0	0	0	3	0	0	3
CO5	3	3	0	3	0	0	0	3	0	0	0	3	0	0	3
CO6	3	3	0	3	0	0	0	3	0	0	0	3	0	0	3
Average	3	3	0	3	0	0	0	3	0	0	0	2.5	0	0	3

Digital System Design

BME11020	Prof. Core- IX (Digital System Design)	L	T	P	C
Version 1.0	**Contact Hours – 45**	3	0	0	3
Pre-requisites/Exposure	Fundamentals of Mechanics				
Co-requisites	--				

Course Objectives:

- To understand switching algebra and simplification of logic expressions.
- To design and implement combinational logic circuits using various logic families and devices.
- To analyze and synthesize sequential circuits using flip-flops and FSM models.
- To design counters, shift registers, and asynchronous circuits.
- To develop digital systems using Algorithmic State Machine (ASM) methodology.

Course Outcomes

On completion of this course, the students will be able to

CO1. Demonstrate understanding of switching theory by analyzing and minimizing Boolean functions using canonical forms and truth table representations.

CO2. Design combinational logic circuits using standard logic gates, universal gates, and programmable devices like ROMs, PLAs, and FPGAs.

CO3. Analyze and construct sequential logic circuits, including flip-flops, latches, and finite-state machines, using both Mealy and Moore models.

CO4. Apply optimization techniques in sequential circuit design, including state minimization, state assignment, and implementation of counters and shift registers.

CO5. Develop control logic using Algorithmic State Machine (ASM) techniques, partitioning control units and synthesizing datapaths with ALUs and control structures.

CO6. Evaluate the performance and functionality of logic circuits across various logic families (TTL, CMOS, nMOS, PTL) and ensure design efficiency for real-world digital applications.

Course Description:

This course introduces the fundamentals of digital logic design and switching theory. It covers combinational and sequential circuit design using logic gates, multiplexers, decoders, and programmable devices. Students learn minimization techniques, design of finite state machines, and implementation of algorithmic state machines. The course emphasizes both theoretical understanding and practical design of digital systems.

Course Content

Module 1: Switching theory - Switching algebra,, switching functions, truth tables and switching expressions – canonical forms, sum-of-product (disjunctive normal) form (dnf) and product-of-sum (conjuctive normal) form (cnf); minimization of completely and inc completely specified switching functions.

Module 2: Combinational logic circuits - Logic gates, Realization of Boolean functions using logic gates – 2 level AND-OR circuits for dnf, 2 level OR-AND circuits for cnf; universality of NAND/NOR gates; Logic families: TTL, nMOS, CMOS, pass transistor logic (PTL) gates; Multi-output logic circuit minimization; Decoders, multiplexers. logic design using ROMs, PLAs and FPGAs.

Module 3: Sequential circuits - latches and flip-flops (FFs); synchronous and asynchronous inputs; edge triggered and master-slave Ffs; Synchronous sequential circuits, finite-state machine (FSM) model, Mealy and Moore machines, synthesis of synchronous sequential circuits.

Module 4: Sequential circuit Design - Minimization and state assignment, incompletely specified m/c's; Counters and shift registers; asynchronous sequential circuit design.

Module 5: Algorithmic State Machines (ASM) - Design steps from algorithmic flowcharts todata path – controller partitioned ASMs, Data path synthesis, ALU and status detection circuits.

Text Books:	
1	H. Taub and D. Schilling, Digital Integrated Electronics, McGraw-Hill
2	Z. Kohavi, Switching and Finite Automata Theory, Tata McGraw-Hill.

Reference Books:	
1	Randy H. Katz and Gaetano Borriello, Contemporary Logic Design, Prentice Hall of India.
2	Giovanni De Micheli, Synthesis and Optimization of Digital Circuits, Tata McGraw-Hill.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Core- IX (Digital System Design)	Course Code:	BME11020

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	0	0	0	0	0	0	0	0	0	0	3
CO2	3	3	3	3	0	0	0	0	0	0	0	0	0	0	3
CO3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	3
CO4	3	3	3	3	0	0	0	0	0	0	0	0	0	0	3
CO5	3	3	3	3	0	0	0	0	0	0	0	0	0	0	3
CO6	3	3	3	3	0	0	0	0	0	0	0	0	0	0	3
Average	3	3	3	3	0	0	0	0	0	0	0	0	0	0	3

Foundation on Artificial Intelligence and Machine Learning

ECE11018	Foundation on Artificial Intelligence and Machine Learning	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	Basic knowledge in Probability and Linear Algebra				
Co-requisites	----				

Course Objectives

1. To equip students with a solid foundation in linear algebra and optimization techniques, enabling them to understand and apply mathematical concepts crucial for data science and machine learning.
2. To introduce students to the essentials of inferential statistics, including probability theory, probability distributions, hypothesis testing, and their practical implementation in Python, fostering the ability to perform rigorous statistical analysis.
3. To provide a comprehensive refresher on Python programming, emphasizing data structures, functional programming, and the use of essential libraries such as NumPy and Pandas for data analysis, manipulation, and visualization.
4. To offer a foundational understanding of artificial intelligence and machine learning, covering their definitions, historical evolution, current trends, and real-world applications, preparing students for further study and practical work in these fields.

Course Outcomes

Course Outcomes

On completion of this course, the students will be able to

CO1. Apply foundational concepts in linear algebra and optimization to formulate and solve mathematical problems relevant to data science and machine learning.

CO2. Interpret and perform statistical analyses involving probability distributions, hypothesis testing, and inferential techniques, including practical implementation using Python.

CO3. Demonstrate proficiency in Python programming by utilizing essential data structures, functional programming constructs, and libraries like NumPy and Pandas for data manipulation.

CO4. Visualize and explore datasets using Python-based tools, effectively communicating trends and insights through graphical representations.

CO5. Describe the scope, evolution, and real-world applications of AI and ML, recognizing

their impact across industries and understanding their foundational principles.

CO6. Integrate mathematical, statistical, and programming knowledge to build a solid foundation for advanced learning in artificial intelligence, machine learning, and data-driven problem solving.

Course Description:

This course provides a comprehensive introduction to the foundational concepts and skills required for data science and machine learning. Students will develop proficiency in linear algebra, optimization techniques, and inferential statistics and will apply these concepts using Python programming. The course emphasizes practical data manipulation and visualization using essential Python libraries like NumPy and Pandas. Additionally, students will gain a foundational understanding of artificial intelligence (AI) and machine learning (ML), exploring their historical context, current trends, and real-world applications. By the end of the course, students will be equipped with the knowledge and skills to tackle complex engineering problems and to engage in advanced studies in AI and ML.

Course Content

Module 1: Mathematical Foundations

Linear Algebra: Vectors, Matrices, Norms, Subspaces, Projections, SVD, EVD, Derivatives of Matrices, Vector Derivative Identities, Least SquaresOptimization: Gradient Descent, Second Derivative Test, Constrained Optimization, KKT

Module 2: Statistics Essentials

Inferential Statistics: Probability, Probability Distributions, and the Central Limit Theorem.Hypothesis Testing: Definition and importance, Components of hypothesis testing: the null hypothesis and alternative hypothesis, steps involved in hypothesis testing. P-Value, different types of tests, and implementation in Python.

Module 3: Programming Refresher

Introduction to Python: Understanding the structure of Python, Data Structures like lists, tuples, and dictionaries. Functional Programming in Python.Python for Data Science: The 2 most important libraries of Python – NumPy and Pandas. NumPy and Pandas are essential for Data Analysis, cleaning, and most of the core Data Science work.Data Visualization in Python: plotting graphs and trends using Python.

Module 4: Introduction to Artificial Intelligence (AI) and Machine Learning (ML)Definition and Scope of AI and ML, Historical overview and current trends, Applications and impact of AI and ML in various industries

Text Books

1. "Introduction to Linear Algebra" by Gilbert Strang, published by Wellesley-Cambridge Press.
2. "Convex Optimization" by Stephen Boyd and Lieven Vandenberghe, published by Cambridge University Press.
3. "Statistics for Engineers and Scientists" by William Navidi, published by McGraw-Hill Education.
4. "Python Crash Course" by Eric Matthes, published by No Starch Press.
5. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig, published by Pearson.
6. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy, published by The MIT Press.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Foundation on Artificial Intelligence and Machine Learning	Course Code:	ECE11018

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	3	1	1	1	1	1	1	2	3	2	2
CO2	3	3	2	2	2	1	1	1	1	2	1	2	3	2	2
CO3	3	3	3	3	3	2	1	1	1	2	2	3	3	3	3
CO4	3	3	3	3	3	2	1	1	1	2	2	3	3	3	3
CO5	3	3	3	3	3	2	2	1	1	2	2	3	3	3	3
CO6	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
Average	3	2.83	2.5	2.67	2.83	1.83	1.5	1.17	1.17	2	1.83	2.67	3	2.67	2.67

Bio-fluid mechanics

BME11021	Prof. Elective- II (Bio-fluid Mechanics)	L	T	P	C
Version 1.0	**Contact Hours – 45**	3	0	0	3
Pre-requisites/Exposure	Physics, chemistry, mathematics				
Co-requisites	--				

Course Objectives:

1. To understand basic physical properties of fluids and evaluate force and pressure balances acting on fluid.
2. To understand hemodynamics and fluid dynamics measurement techniques in human circulation system
3. To understand transport in internal organs and in external field.
4. To understand Computational Analysis Techniques and to evaluate and design biofluid mechanics problems

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand and apply fundamental fluid mechanics principles, including Reynolds' transport theorem and conservation laws, to analyze various flow regimes and dimensional systems.

CO2. Analyze the rheological behavior of blood and model hemodynamic phenomena in both normal and pathological conditions using equations like the Casson model.

CO3. Model mass and fluid transport processes in internal organs, including gas exchange in the lungs, filtration in the kidneys, and intraocular and vestibular fluid dynamics.

CO4. Examine biological fluid interactions in external environments, such as aquatic and aerial locomotion in organisms, utilizing principles of propulsion, lift, and drag reduction.

CO5. Implement and evaluate numerical methods such as Finite Volume Method (FVM) and discretization schemes for solving fluid flow and transport problems computationally.

CO6. Integrate analytical and computational tools to simulate and assess biofluid systems, connecting physical fluid dynamics with physiological transport processes.

Course Description

This course explores fluid mechanics in the context of the human circulatory system. Principal equations are derived from differential analysis of fluid flow, and models of characteristic flow conditions are fully analyzed. Biofluid mechanics, vessel biomechanics, and hemodynamic analysis of the circulation system will also be discussed.

Course Content

Module 1: Basics of fluid mechanics: Properties of Newtonian and non-Newtonian fluids; field approach; control volume; Reynolds' transport theorem; principles of continuity, conservations of mass, energy and momentum and their applications; laminar and turbulent flows and boundary layer; dimensional analysis and similarity; unsteady flow and non-uniform geometric models.

Module 2: Hemodynamics: Rheological properties of blood and, effects of blood viscosity variation; hemodynamics; Casson equation; blood flow in microcirculation; blood flow in vascular and heart diseases; fluid dynamics measurement techniques relevant to blood flow.

Module 3: Transport in internal organs: Diffusion processes in human systems; gas exchange in the pulmonary system; Pulmonary flow in diseased condition; blood flow and sodium transport in the kidney; transport in digestive system; fluid dynamics in vestibular system; intraocular fluid flow.

Module 4: Transport in external field: Fluid dynamics of swimming, bacterial swimming, maneuvering and propulsion of underwater creatures; Fluid mechanics of insect and bird flight; theory of lift; concept of drag reduction.

Module 5: Computational Analysis Techniques: Finite volume method (FVM); Central differencing scheme; Upwind differencing scheme; Hybrid differencing scheme; Properties of discretisation schemes: Conservativeness; Boundedness; Transportiveness; FVM for steady state diffusion problems; Steady one-dimensional convection and diffusion; Power-law scheme; The quadratic upstream interpolation for convective kinetics (QUICK) scheme.

Books:

1.Biofluid Mechanics: The Human Circulation By Krishnan B. Chandran, Stanley E. Rittgers, Ajit P. Yoganathan

2.Biofluid Mechanics: An Introduction to Fluid Mechanics, Macrocirculation, and Microcirculation By David Rubenstein, Wei Yin, Mary D. Frame

3. Introduction to Biofluid Mechanics by C.T. John K. Clark

4. Mechanics of the Circulation by C.G. Caro, T.J. Pedley, R.C. Schroter, W.A. Seed

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Elective- II (Bio-fluid Mechanics)	Course Code:	BME11021

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO2	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO3	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO4	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO5	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO6	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
Average	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3

Bioinformatics

BME11022	Prof. Elective- II Bioinformatics	L	T	P	C

Version 1.0	**Contact Hours – 45**	3	0	0	3
Pre-requisites/Exposure	Physics, chemistry, mathematics, biology				
Co-requisites	--				

Course Objectives:

1. To introduce the fundamentals of bioinformatics and its applications in medicine, agriculture, and drug discovery.
2. To familiarize students with key biological databases (e.g., GenBank, UniProt, PDB) and sequence data formats (FASTA, GenBank).
3. To enable students to perform sequence analysis, genome annotation, and phylogenetic studies.
4. To develop skills in molecular docking, protein structure prediction, and molecular modeling.
5. To explore genomics, proteomics, and next-generation sequencing (NGS) technologies.
6. To understand systems biology, disease pathway modeling, and network analysis.
7. To apply machine learning and AI techniques in bioinformatics for disease prediction and drug discovery.

Course Outcomes

On completion of this course, the students will be able to

CO1. Demonstrate foundational knowledge of core bioinformatics principles and their interdisciplinary relevance in medicine, agriculture, and drug development.

CO2. Utilize biological databases and sequence analysis tools to interpret genetic and protein sequences for solving real-world biological problems.

CO3. Apply advanced methodologies in genomics and proteomics, including next-generation sequencing and structural bioinformatics, to analyze complex biological systems.

CO4. Design and implement computational models using machine learning, systems biology, and network analysis to explore disease mechanisms and accelerate therapeutic discoveries.

CO5. Critically assess ethical, legal, and social dimensions of bioinformatics research, focusing on genomic privacy, data sharing, and AI governance in life sciences.

CO6. Demonstrate proficiency in Python and R for data handling, visualization, and solving

bioinformatics challenges, with applications in personalized medicine and precision healthcare.

Course Description:

This course introduces the fundamentals and advanced concepts of bioinformatics, covering biological databases, sequence analysis, molecular docking, genomics, proteomics, and systems biology. It explores the integration of AI and machine learning in biological research, addresses ethical and legal issues, and offers hands-on experience with Python and R for data analysis and visualization. Through real-world case studies, students will gain insights into current innovations and applications in personalized medicine and precision health.

Course Content

Module 1: Introduction to Bioinformatics and its applications in Medicine, Agriculture, and Drug Discovery, Bioinformatics Databases & Resources, Biological Databases & Data Retrieval, Overview of Biological Databases (GenBank, UniProt, PDB), Sequence Data Formats (FASTA, GenBank), Comparative Genomics & Genome Annotation, Sequence Analysis & Alignment, Phylogenetics & Evolutionary Relationships, Molecular Docking & Structure Prediction.

Module 2: Genomics & Next-Generation Sequencing (NGS), High-throughput Sequencing Technologies, Genome Assembly & Annotation, Proteomics & Structural Bioinformatics, Predicting Protein Structures & Functions, Molecular Modeling& Simulation, Protein-Protein Interactions & Drug Targeting.

Module 3: Systems Biology & Network Analysis, Computational Approaches to Disease Pathways, Machine Learning & AI in Bioinformatics, Predictive Models in Disease & Drug Discovery

Module 4: Ethical & Legal Considerations in Bioinformatics, Bioethics in Computational Biology, Privacy & Security in Genomic Data, Intellectual Property & Open Science, Ethical Issues in AI-Driven Biological Research.

Module 5: Practical Implementation in Python & R, Data Visualization Techniques, Future Trends & Innovations in Bioinformatics,Personalized Medicine & Precision Health,Case Studies & Real-world Applications.

Books:

1.Bioinformatics: Sequence and Genome Analysis by David W. Mount

2. Biological Sequence Analysis *by* Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison
3. Bioinformatics: Principles and Applications by G. S. Rao & R. Saravanakumar
4. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins *by* Andreas D. Baxevanis & B.F. Francis Ouellette
5. Essential Bioinformatics by Jin Xiong

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Mid Term**	**Class Assessment**	**End Term**
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Elective- II (Bioinformatics)	Course Code:	BME11022

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	1	0	0	0	0	3	3	3
CO2	3	3	3	3	3	1	1	1	0	0	0	0	3	3	3
CO3	3	3	3	3	3	1	1	1	0	0	0	0	3	3	3
CO4	3	3	3	3	2	1	1	2	0	0	0	0	3	3	3
CO5	3	3	3	3	2	3	1	3	3	3	0	0	3	3	3
CO6	3	3	3	3	2	1	1	3	0	3	0	0	3	3	3
Average	3	3	3	3	2.3	1.3	1	1.8	3	3	0	0	3	3	3

Hospital management system

BME11023	Prof. Elective- II **Hospital management system**	L	T	P	C
Version 1.0	**Contact Hours – 45**	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives:

- To understand the core components of hospital information systems (HIS) and their role in patient management.
- To gain knowledge of electronic health records (EHR) integration and efficient tracking of inpatient and outpatient services.
- To learn about medical billing, insurance claims processing, and staff credentialing systems.
- To explore inventory and pharmacy management including expiry monitoring and e-prescriptions.
- To understand diagnostic support systems including lab and imaging report management.
- To study financial modules, ICU monitoring, housekeeping scheduling, and real-time crisis alert systems.
- To understand data privacy, role-based access control, and encryption methods in HIS.
- To explore telemedicine technologies and AI-driven tools for hospital performance and predictive healthcare analytics.

Course Outcomes

On completion of this course, the students will be able to

CO1. Demonstrate a comprehensive understanding of healthcare information systems, encompassing patient and staff management, insurance workflows, credential verification, and the architecture of electronic health records (EHR).

CO2. Implement and manage EHR systems effectively, ensuring data accuracy, interoperability, compliance, and streamlined access across healthcare functions.

CO3. Optimize hospital resource utilization, including pharmaceuticals, diagnostics, imaging systems, and medical inventory, to support timely and high-quality patient care.

CO4. Coordinate real-time clinical operations, such as ICU and emergency response systems, financial workflows, and incident alerts, to improve healthcare service delivery and

responsiveness.

CO5. Apply advanced cybersecurity measures—including encryption, biometric authentication, and role-based access—to protect patient data and maintain compliance with legal and ethical standards.

CO6. Leverage data-driven technologies like AI analytics, predictive models, and telehealth platforms to support evidence-based decision-making and personalized healthcare delivery.

Course Description:

This course provides a comprehensive overview of Hospital Information Systems (HIS), covering patient management, EHR integration, inventory control, diagnostics, billing, and security. It equips students with the knowledge to handle administrative and clinical functions using technology-driven solutions. Emphasis is placed on real-time data access, privacy, telemedicine, and AI-based healthcare insights to enhance hospital efficiency and patient outcomes.

Course Content

Module 1: Patient Management, Electronic Health Records (EHR) Integration, Inpatient & Outpatient Tracking, Billing & Insurance Processing, Doctor & Staff Management, Credential & Licensing Verification.

Module 2: Medical Inventory & Pharmacy Management, Expiry Date Monitoring, Prescription Management & E-Prescriptions, Laboratory & Diagnostic Management, Imaging & Radiology Reporting.

Module 3: Financial & Billing System, Insurance Claims Processing, ICU & Emergency Unit Monitoring, Housekeeping & Maintenance Scheduling, Real-time Patient Status Monitoring, Crisis Alerts & Incident Reporting.

Module 4. Security & Access Control, Role-Based Access to Patient Data, Confidentiality & Encryption Measures, Biometric Authentication & Log Tracking.

Module 5: Telemedicine & Remote Healthcare Services,Hospital Performance Metrics, Disease Trend Analysis, Predictive Healthcare Insights, AI-Based Decision Support.

Books:

1. Health Information Systems: Architectures and Strategies by Alfred Winter, Reinhold Haux, Elske Ammenwerth, Birgit Brigl
2. Hospital Information Systems: A Guide to Implementation and Management by Mohan Bansal

3. Health Informatics: An Interprofessional Approach by Ramona Nelson & Nancy Staggers
4. Essentials of Health Information Systems and Technology by Jean A. Balgrosky
5. Biomedical Informatics: Computer Applications in Health Care and Biomedicine Editors: Edward H. Shortliffe & James J. Cimino

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Elective- I (Hospital Management system)	Course Code:	BME11023

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	2	2	2	1	2	3	3	3	2	3	3	3
CO2	2	3	3	3	3	1	2	3	2	3	2	2	3	3	3
CO3	3	2	3	2	3	0	0	0	3	3	2	2	3	3	3
CO4	3	2	3	2	3	0	0	0	3	3	2	2	3	3	3
CO5	3	3	3	3	3	3	0	2	3	3	3	2	3	3	3
CO6	3	3	3	3	3	3	0	2	3	3	3	2	3	3	3
Average	2.8	2.3	3	1.8	2.8	2.25	1.5	2.25	2.8	3	2.5	2	3	3	3

Biomedical Instrumentation – I Lab

BME12024	Prof. Core- X Lab (Biomedical Instrumentation – I Lab)	L	T	P	C
Version 1.0	**Contact Hours – 30**	0	0	3	1
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives:

- To familiarize students with the microscopic examination of biological specimens using permanent slides.
- To enable accurate measurement of pH using a pH meter.
- To train students in glucose estimation using a glucometer.
- To provide hands-on experience in measuring fluid viscosity using a viscometer.
- To acquire and analyze electrocardiogram (ECG) signals for cardiac function assessment.
- To acquire and interpret electroencephalogram (EEG) signals for brain activity monitoring.
- To evaluate auditory function using a pure-tone audiometer.
- To perform blood pressure measurement using a sphygmomanometer and stethoscope.
- To assess lung capacity and respiratory function using a spirometer.

Course Outcomes

On completion of this course, the students will be able to

CO1. Demonstrate proficiency in basic biomedical instrumentation techniques by measuring pH, viscosity, glucose levels, and blood pressure using standard equipment.

CO2. Analyze microscopic anatomical structures through systematic observation and interpretation of permanent biological slides under the microscope.

CO3. Acquire and interpret physiological signals such as ECG and EEG, using appropriate biomedical devices and signal analysis tools.

CO4. Evaluate respiratory and auditory functions by conducting spirometry and pure-tone audiometry tests, and interpreting the physiological data.

CO5. Integrate experimental methods and diagnostic tools to assess fundamental biochemical and biophysical parameters in human systems.

CO6. Apply laboratory safety practices and documentation standards while operating biomedical instruments and recording test results for clinical and analytical evaluation

Course Description:

This course offers practical training in basic biomedical techniques and diagnostic tools. Students will gain hands-on experience in using laboratory and clinical instruments for analyzing physiological signals, assessing vital parameters, and performing fundamental biomedical measurements essential for healthcare and research applications.

Course Content

List of experiments

1. Study of permanent slides under microscope
2. Measurement of pH using pH meter
3. Estimation of glucose using glucometer
4. Measurement of viscosity using viscometer
5. Acquisition and analysis of ECG signal
6. Acquisition and analysis of EEG signal
7. Evaluation of auditory function using a pure-tone audiometer
8. BP measurement using sphygmomanometer and stethoscope
9. Determination of lung capacity using Spirometer

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Core- X Lab (Biomedical Instrumentation – I Lab)	Course Code:	BME12024

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO2	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO3	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO4	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO5	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO6	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
Average	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3

Biomechanics Lab

BME12025	Prof. Core- IX Lab (Biomechanics Lab)	L	T	P	C
Version 1.0	**Contact Hours – 30**	2	0	0	1
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives:

- To study joint movement and gait cycle using clinical and computational tools.
- To understand respiratory mechanics and muscle activity through EMG analysis.
- To determine the mechanical properties of muscles, cartilage, and bones using a universal testing machine.
- To develop basic mechanical models using CAD software.
- To analyze biomechanical systems and stress-strain behavior of joints using Finite Element Analysis (FEA).

Course Outcomes

On completion of this course, the students will be able to

CO1. Assess joint mobility and human locomotion by measuring range of motion with goniometers and analyzing gait cycles using both observational and computational approaches.

CO2. Apply principles of respiratory biomechanics to understand and interpret mechanical aspects of breathing and lung function.

CO3. Utilize surface EMG systems for recording, processing, and interpreting neuromuscular electrical activity in muscles during movement and exertion.

CO4. Determine the biomechanical properties of biological tissues—muscles, cartilage, and bone—using universal testing machines and interpret stress-strain behavior under various conditions.

CO5. Develop and simulate anatomical models in CAD and Finite Element Analysis (FEA) platforms, enabling structural analysis of joints under mechanical loads.

CO6. Analyze stress-strain distributions in human joints, particularly the knee and elbow, through FEA-based evaluation to predict tissue performance and assess mechanical function.

Course Description:

This course provides practical exposure to biomechanical analysis of the human body through joint movement measurement, gait analysis, and EMG handling. It includes mechanical testing of biological tissues using a universal testing machine and the development of anatomical models using CAD and FEA tools for stress-strain analysis of musculoskeletal joints

Course Content

List of experiments:

1. Measurement of range of movements of different joints using goniometer

2. Demonstration of gait cycle.

3. Analysis of gait using computational models.

4. Respiratory mechanics

5. Handling EMG

6. Determination of mechanical properties of muscles using universal testing machine

7. Determination of mechanical properties of cartilages using universal testing machine

8. Determination of mechanical properties of bone using universal testing machine

9. Building simple mechanical models in CAD software.

10. Analysis of the exported CAD model in FEA platform.

11. Analysis of stress-strain distribution for knee joint using FEA.

12. Analysis of stress-strain distribution for elbow joint using FEA.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Core-IX Lab (Biomechanics Lab)	Course Code:	BME12025

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO2	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO3	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO4	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO5	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO6	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
Average	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3

Digital System Lab

BME12026	Prof. Elective - I (Digital System Lab)	L	T	P	C
Version 1.0	**Contact Hours – 30**	0	0	2	1
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives:

1. To understand the various basic logic gates
2. To design and implement the various combinational circuits
3. To design and implement sequential circuits
4. To design and implement ASM devices

Course Outcomes

On completion of this course, the students will be able to

CO1. Analyze and interpret the electrical characteristics of TTL and CMOS logic gates, using oscilloscopic tools to understand their real-world behavior.

CO2. Design and implement combinational logic circuits, including decoders, multiplexers, ALUs, and display drivers, using Boolean minimization techniques in both DNF and CNF forms.

CO3. Construct and verify sequential logic circuits, such as flip-flops, shift registers, and counters, incorporating both discrete gate logic and ICs like 555 timers.

CO4. Develop Algorithmic State Machine (ASM) models for practical control systems such as traffic lights or vending machines, and implement them using suitable logic components.

CO5. Demonstrate proficiency in translating theoretical logic designs into functional hardware circuits, validating each stage through simulation or physical testing.

CO6. Collaborate effectively in a lab environment, applying systematic troubleshooting and documentation practices to complete digital system design tasks.

Course Description

It is a core course for all UG Biomedical Engineering students. Topics covered will focus on the design of digital systems using combinational, sequential, and programmable logic devices. Techniques for logic design including asynchronous logic, physical world interfaces to digital systems, and system

performance analysis methods will be studied.

Course Content

List of Experiments:

1. TTL and CMOS Gates: Study the characteristics of TTL and MOS gates, Display of the characteristics on oscilloscopes.

2. Combinational logic circuits: Design and implementation of switching functions using minimization for both dnf and cnf; Design of decoders, multiplexor – demultiplexor, adder / subtractor, ALU, comparators, 7-segment LED display driver, etc.

3. Sequential Circuits: D FF and JK FF state transition function verification, Implementation of JK master-slave FF using logic gates, Astable and monostableckt. using a 555 timer chip, Design of a 4 bit universal shift register with parallel load, shift-left and shift-right facility, Design of sequencegenerators and detectors, counters.

4. design of ASMs such as, traffic light controllers, vending machine, keyboard interface etc. (any one).

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Elective - I (Digital System Lab)	Course Code:	BME12026

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO2	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO3	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3

CO4	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO5	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO6	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
Average	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3

Modelling and Simulations of Biomedical Systems Lab

BME12027	Prof. Elective - I **Modelling and Simulations of Biomedical Systems Lab**	L	T	P	C
Version 1.0	**Contact Hours – 30**	0	0	2	1
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives:

- To introduce fundamental modeling concepts and differential equations applied to biological systems.
- To simulate cardiovascular and respiratory system dynamics using computational methods.
- To model drug delivery systems using pharmacokinetic and pharmacodynamic principles.
- To apply computational techniques for modeling neural activity and brain signal processing.
- To simulate musculoskeletal movements and analyze human motion biomechanics.
- To model cell growth and simulate tissue engineering processes.
- To understand and apply biomedical image processing techniques for scan analysis.
- To develop models for disease progression and tumor growth prediction.
- To integrate AI and machine learning for predictive modeling in healthcare.
- To simulate and analyze biosignals like EEG and EMG for diagnostic purposes.

Course Outcomes

On completion of this course, the students will be able to

CO1. Develop mathematical and computational models for simulating complex biological systems, including cardiovascular, neural, respiratory, and musculoskeletal dynamics.

CO2. Analyze drug kinetics and delivery pathways through pharmacokinetic/pharmacodynamic (PK/PD) modeling and simulate ADME processes in virtual patient scenarios.

CO3. Construct and interpret biomedical signal processing workflows, including simulation and feature extraction of biosignals like EEG, EMG, and ECG.

CO4. Apply AI and machine learning algorithms to biomedical data for tasks such as diagnosis, patient outcome prediction, and telemedicine-based health monitoring.

CO5. Simulate tissue and cellular behaviors using mathematical models to explore cell proliferation, tissue regeneration, and disease progression dynamics like tumor growth.

CO6. Utilize image processing and modeling tools for biomedical imaging applications such as segmentation, feature extraction, and reconstruction of CT/MRI scans.

Course Description:

This course focuses on mathematical and computational modeling of biomedical systems, including cardiovascular, neural, respiratory, and drug delivery processes. It integrates simulation techniques, image processing, biomechanics, and biosignal analysis with applications of AI and machine learning to predict disease progression, analyze physiological data, and support medical decision-making.

Course Content

List of Experiments:

1. Introduction to Biomedical System Modeling - Understanding basic modeling concepts in biological systems, Introduction to differential equations for biological processes

2. Simulation of Cardiovascular Dynamics - Modeling blood flow using computational fluid dynamics (CFD), Simulation of heart rate variability and ECG signals

3. Drug Delivery System Modeling - Pharmacokinetics and pharmacodynamics (PK/PD) modeling, Simulation of drug absorption, distribution, metabolism, and excretion (ADME)

4. Neural System Modeling - Computational modeling of neuron firing patterns, Simulation of brain signal processing using artificial neural networks

5. Respiratory System Simulation - Lung mechanics and gas exchange modeling, Spirometry data simulation and analysis

6. Biomechanics and Human Motion Simulation - Musculoskeletal modeling of joint movements, Simulation of gait cycle and posture analysis

7. Cell Growth and Tissue Engineering Simulation - Mathematical modeling of cell proliferation, Simulation of tissue regeneration processes

8. Biomedical Image Processing - Image segmentation and feature extraction of medical scans, Simulation of MRI and CT scan image reconstruction techniques

9. Disease Progression Modeling - Epidemiological modeling for disease spread prediction, Computational modeling of cancer growth and tumor dynamics

10. Artificial Intelligence and Machine Learning in Biomedical Systems - AI-driven predictive modeling for medical diagnosis, Machine learning algorithms for patient outcome predictions

11. Biosignal Processing and Analysis - Simulation of EEG and EMG signals, Feature extraction techniques for biosignals

12. Telemedicine and Health Monitoring Simulations - Wearable sensor data simulation for remote patient monitoring, Predictive modeling for health risk assessments

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Elective - I Modelling and Simulations of Biomedical Systems Lab	Course Code:	BME12027

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	1	0	0	2	0	0	0	3	3	3
CO2	3	3	3	3	3	1	0	0	2	0	0	0	3	3	3
CO3	3	3	3	3	3	1	0	0	2	0	0	0	3	3	3
CO4	3	3	3	3	3	1	0	0	2	0	0	0	3	3	3
CO5	3	3	3	3	3	1	0	0	2	0	0	0	3	3	3
CO6	3	3	3	3	3	1	0	0	2	0	0	0	3	3	3
Averag e	3	3	3	3	3	1	0	0	2	0	0	0	3	3	3

AI-ML Lab

ECE12046	Prof. Elective - I **AI-ML Lab**	L	T	P	C
Version 1.0	**Contact Hours – 30**	0	0	2	1
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives:

- To introduce the fundamentals of AI and ML using Python and essential libraries like NumPy, Pandas, and Matplotlib.
- To implement and evaluate supervised learning algorithms such as regression and classification models.
- To explore unsupervised learning techniques like clustering for data segmentation.
- To understand the basics of neural networks, deep learning, and their applications.
- To apply CNNs for image classification and NLP techniques for text analysis.

- To introduce reinforcement learning concepts and build simple agents using Q-learning.
- To explore generative AI using GANs for synthetic data generation.
- To develop time-series forecasting models using LSTM networks.
- To promote ethical and responsible use of AI through fairness and explainability.
- To apply AutoML and hyperparameter tuning techniques for optimizing model performance.

Course Outcomes

On completion of this course, the students will be able to

CO1. Set up and utilize Python environments with libraries like NumPy, Pandas, and Matplotlib for data preprocessing, visualization, and AI/ML model development.

CO2. Implement and evaluate machine learning models including regression, classification, clustering, and deep learning architectures such as feedforward and convolutional neural networks.

CO3. Develop and deploy natural language processing solutions by applying text preprocessing, sentiment analysis, and word embedding techniques like Word2Vec and GloVe.

CO4. Apply reinforcement learning algorithms such as Q-learning and model Markov Decision Processes to solve decision-making problems in dynamic environments.

CO5. Design and evaluate generative AI models including GANs for synthetic data generation, and analyze time-series data using models like LSTM for forecasting.

CO6. Integrate responsible AI practices by identifying biases, applying explainable AI methods, and optimizing models using tools like GridSearchCV and AutoML frameworks.

Course Description:

This course offers a comprehensive introduction to Artificial Intelligence and Machine Learning with practical implementation using Python. It covers supervised and unsupervised learning, deep learning, NLP, reinforcement learning, generative models, and time-series forecasting. Students will also explore AutoML, model evaluation techniques, and ethical considerations in AI applications through hands-on projects and case studies.

Course Content

List of Experiments:

1. Introduction to AI & ML - Setting up Python environment for AI/ML, Basics of NumPy, Pandas, and Matplotlib, Understanding dataset preprocessing techniques.

2. Supervised Learning - Regression Models - Implementing Linear Regression, Polynomial Regression experiment, Evaluating performance using RMSE and R^2 score.

3. Supervised Learning - Classification Models, Implementing Logistic Regression for binary classification, Building Decision Tree and Random Forest models, Evaluating classification performance using confusion matrix.

4. Unsupervised Learning - Clustering Algorithms, Implementing K-Means clustering, Hierarchical clustering and dendrogram analysis, Applications in customer segmentation.

5. Neural Networks & Deep Learning Basics - Introduction to Perceptron model, Implementing Feedforward Neural Networks, Activation functions and backpropagation.

6. Convolutional Neural Networks (CNNs) - Image classification using CNN, Training a model on MNIST dataset, Understanding convolution layers and filters

7. Natural Language Processing (NLP) - Text preprocessing (Tokenization, Stopwords removal), Implementing Sentiment Analysis using NLP models, Word embeddings with Word2Vec and GloVe.

8. Reinforcement Learning Basics - Introduction to Reinforcement Learning concepts, Building a simple Q-learning agent, Solving Markov Decision Process (MDP).

9. Generative AI & GANs - Introduction to Generative Adversarial Networks (GANs), Training a model to generate synthetic images, Exploring applications in data augmentation

10. Time-Series Analysis & Forecasting - Implementing LSTM for time-series forecasting, Predicting stock prices or weather trends using ML, Evaluating model performance with MSE and MAE

11. AI Ethics & Responsible AI - Bias detection in AI models, Explainable AI techniques, Case study on fairness in AI applications

12. AutoML&Hyperparameter Tuning - Using GridSearchCV for hyperparameter optimization, Applying AutoML tools for model selection, Comparing manual vs. automated ML techniques

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Elective - I **AI-ML Lab**	Course Code:	ECE 12046

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	3	3	3	1	0	0	2	1	0	0	1	3	3
CO2	3	2	3	3	3	1	0	0	2	1	0	0	1	3	3
CO3	3	2	3	3	3	1	0	0	2	1	0	0	1	3	3
CO4	3	2	3	3	3	1	0	0	2	1	0	0	1	3	3
CO5	3	2	3	3	3	1	0	0	2	1	0	0	1	3	3
CO6	3	2	3	3	3	1	0	0	2	1	0	0	1	3	3
Average	3	2	3	3	3	1	0	0	2	1	0	0	1	3	3

SEMESTER VI

BME11028	Prof. Core- XII Biological Control Systems	L	T	P	C
Version 1.0	Contact Hours - 60	3	1	0	4
Pre-requisites/Exposure	12th level Physics, Chemistry, and Mathematics, life science				
Co-requisites	--				

Course Objectives:

- To introduce the fundamentals of control systems, including open-loop and closed-loop systems.
- To develop mathematical models of control systems using block diagrams, transfer functions, and signal flow graphs.
- To analyze the stability and performance of control systems using time-domain techniques such as Routh-Hurwitz criteria and root locus.
- To study frequency domain analysis using Bode plots, Nyquist plots, and related stability criteria.
- To understand feedback mechanisms and control strategies in biological systems such as temperature regulation, glucose control, and homeostasis.
- To explore physiological control models in respiratory, cardiovascular, and neuromuscular systems.
- To examine the role of biological receptors, hormonal regulation, and neural control in maintaining body function.

Course Outcomes

On completion of this course, the students will be able to

CO1:Explain the basic concepts of control systems including open-loop and closed-loop systems,

CO2:Derive mathematical models using block diagrams, transfer functions, and signal flow graphs.

CO3:Analyze the stability of linear time-invariant systems using Routh-Hurwitz criteria and evaluate time-domain performance using test signals, root locus, and error constants.

CO4:Interpret the frequency-domain characteristics of control systems using Bode plots, polar plots, and Nyquist criteria to assess system stability and performance.

CO5:Describe and compare feedback mechanisms in biological systems, such as homeostasis

and physiological regulation, and model them mathematically. CO6: Analyze and model specific biological control systems such as respiratory, cardiovascular, neural, and endocrine systems, and evaluate their control mechanisms.

Course Description:

This course provides a comprehensive introduction to control systems with an emphasis on both engineering and biological applications. It covers mathematical modeling, time and frequency domain analysis, and stability assessment using classical methods. The course also explores physiological control mechanisms such as homeostasis, neural regulation, and feedback loops in systems like the respiratory and cardiovascular systems, linking engineering principles to biological functions.

Course Content

Module I- Introduction to control systems &Mathematical modeling of control system Introduction to control system:Open loop and closed loop system and illustrations. Mathematical modeling of control system: Block diagram representation of control system; Transfer function, Block reduction techniques and Signal flow graphs. State space Analysis; AC-DC servo motors, characteristics of feed back and feed forward back control system.

Module II- Stability & Time domain analysis Stability: Concept of stability, Necessary conditions for stability, Pole-zero locations in S-plane forstabilitystudy ;Routh and RouthHerwitz stability criteria. Time domain analysis:Use of standard test signals for time response study; Time response 2ndorder system.Performance specification steady state error constants. Root locus techniqueconceptand construction of root locus and driving stability information.

Module III- Frequency domain analysis Frequency domain analysis:Closed loop frequency response performance specifications; frequency response curve; Relationbetween time and frequency domain specification. Polar plot; Bode plots-gain margin and phasemargin for stability determination.Derivation of transfer function form Bode plots. Nyquist stability Criterion-Stability and relativestability study lines using Nyquist plots.

Module IV- Introduction to Biological Control Systems Feedback mechanisms in biological processes, Open-loop vs. closed-loop control, Mathematical representation of physiological

systems. Physiological Feedback and Homeostasis, Basic concepts of homeostatic regulation, Examples: Temperature regulation, pH balance, glucose control, Negative vs. positive feedback loops in biological systems

Module V-Respiratory models & System Respiratory models & System, Cardiovascular control system.Skeletal muscles servomechanism Biological receptors. Neural Control Systems, Respiratory System and Control Mechanisms, Hormonal regulation

xt Books:	
1	Control Systems by Smarjit Ghosh, Pearson, second Impression, 2013
2	Control System Engg, by I.J.Nagrath& M Gopal, New age international publication, 4th Edition,2011.
3	**Biological Control Systems and Biofeedback** by John Enderle
Reference Books:	
1	Automatic Control Systems by Benjamin C. Kuo, Prentice-Hall, 7th Edition, 2009.
2	Modern Control Engg. by K. Ogata PHI publication, 5th Edition, 2010.
3	Automatic control system by HasanSaeed, sixth revised edition 2008, S.K. Kataria& Sons.
4	**Modeling and Control of Biological Systems** by Arthur T. Johnson

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Core- XII **Biological Control Systems**	Course Code:	BME11028

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	0	0	3	0	0	0	0	0	0	0	1	1	2
CO2	3	3	0	3	3	0	0	0	0	0	0	0	1	1	2
CO3	3	3	0	3	3	0	0	0	0	0	0	0	1	1	2

CO4	3	3	3	3	3	0	0	0	0	0	0	0	1	1	2
CO5	3	3	3	3	3	0	0	0	0	0	0	0	2	2	3
CO6	3	3	3	3	3	0	0	0	0	0	0	0	3	3	3
Average	3	3	3	3	3	0	0	0	0	0	0	0	1.5	1.5	2.3

Digital Image Processing

BME11029	**Prof. Core- XIII (Digital Image Processing)**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hours - 45**	3	1	0	4
Pre-requisites/Exposure	12th level Physics, Chemistry, and Mathematics and basic knowledge of Computers				
Co-requisites	--				

Course Objectives

1. To become familiar with digital image fundamentals
2. To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
3. To learn concepts of degradation function and restoration techniques.
4. To study the image segmentation and representation techniques.
5. To become familiar with image compression and recognition methods

Course Outcomes

CO1 Understanding the fundamentals of image representation, sampling, and transforms

CO2 Applying image enhancement and segmentation techniques in medical image processing

CO3 Understanding and implementing image compression techniques

CO4 Analyzing and classifying medical images using feature extraction techniques

CO5 Implementing image registration and visualization techniques

CO6 Developing a comprehensive understanding of the medical image processing workflow

Course Description

For engineering course, Mathematics is the backbone. Students will be having good engineering skills if their idea for Mathematics is clear. In this course the focus will be to learn Mathematics in depth which will motivate students to grow their thinking ability for Engineering also. By knowing the theory student will be able to apply that successfully to all kind of problems of Engineering and science. Class participation is a fundamental aspect of this course. Students will be encouraged to actively take part in all group activities (Problem solving, presentation etc.).

Course Content

Module 1: Fundamentals of Image processing and Image Transforms, Medical Image Representation: Pixels and voxels – algebraic image operations - gray scale and color representation. Image files formats- DICOM- other formats, Basic steps of Image processing system sampling and quantization of an Image: Basic relationship betweenpixels, Image Transforms: 2D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet, transforms.

Module 2: Image Processing Techniques: Image Enhancement, Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters, Frequency Domain methods - Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation.

Module 3: Image Compression: Image compression fundamentals: coding Redundancy, spatial and temporal redundancy, Compression models: Lossy and Lossless, Huffman coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding , wavelet coding, JPEG standards.

Module 4: Medical Image Analysis and Classification: Feature extraction and representation, feature and image, classification – Statistical, Rule based, Neural Network approaches, Image Registration and Visualization: Rigid body visualization, Principal axis registration.

Text Books:	
1	"Digital Image Processing", Gonzaleze and Woods, 3 rdedition , Pearson.
2	"Handbook of image and video processing", Bovik, Alan C. Academic press, 2010.
3	Wolfgang Birkfellner, „Applied Medical Image Processing – A Basic course", CRC Press, 2011.
Reference Books:	
1	"Digital video Processing", M. Tekalp, Prentice Hall International.
2	"Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab", Chris Solomon, Toby Breckon, John Wiley & Sons.
3	AtamP.Dhawan, „Medical Image Analysis", Wiley Interscience Publication, NJ, USA 2003.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Core- XIII (Digital Image Processing)	Course Code:	BME11029

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	0	3	3	0	0	0	0	0	0	0	0	0	0

CO2	3	3	0	3	3	0	0	0	0	0	0	0	0	0	0
CO3	3	3	0	3	3	0	0	0	0	0	0	0	0	0	0
CO4	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0
CO5	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0
CO6	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0
Average	3	3	1.5	3	3	0	0	0	0	0	0	0	0	0	0

Economics for Engineers

ECO11505	HSSM –IV (Economics for Engineers)	L	T	P	C
Version 1.0	Contact Hours – 45	3	0	0	3
Pre-requisites/Exposure	12th level Mathematics				
Co-requisites					

Course Objectives

1. Prepare engineering students to function in the business and management side of professional engineering practice.

2. Help students in general to analyse, understand and explain the past, present economic conditions of the country.

3. To forecast the future course of changes and development through their knowledge of policies and programmes set by the governments and other development agencies.

4. Evaluate the economic theories, cost concepts and pricing policies.
5. Apply the concepts of financial management for project appraisal.

Course Outcomes

On completion of this course, the students will be able to

CO1. Explain foundational microeconomic concepts such as maximization, equilibrium, and efficiency in the context of individual-level decision-making.

CO2. Analyze economic theories including consumer behavior, supply and demand, market structures, and asset pricing models under certainty and uncertainty.

CO3. Evaluate the sustainability of projects by planning budgets, estimating costs, and assessing long-term feasibility and resource allocation.

CO4. Perform economic feasibility studies by examining real-world challenges such as market failure, pricing strategies in oligopoly, and economic volatility.

CO5. Assess commercial, financial, and technical viability of projects through structured

evaluations and real-life case-based modeling.

CO6. Apply economic reasoning and tools like game theory and risk analysis to project development, resource planning, and strategic decision-making.

Course Description

This paper introduces students to the terminology and analytic principles used in microeconomics, which is broadly defined as the study of markets, and to the application of these conceptual tools to several policy issues. As the design and manufacturing process become more complex, an engineer is required to make decisions that involve money more than ever before. The competent and successful engineer at present must have an improved understanding of the principles of economics. This paper is concerned the analysis of individual behaviors and market structure, and systematic evaluation of the benefits and costs of projects involving engineering design and analysis.

Course Content

Module 1: Basic Concepts of Economics, Introduction to the Literature of Microeconomics centering around Decision Making at Individual Level. Some Fundamental Concepts: Maximization, Equilibrium and Efficiency.

Module 2: Theories of Economics, The Theory of Consumer Choice and Demand, the Theory of Supply, market equilibrium, market structure, market failure and environmental issues, Game Theory, concept of yield and Theories of Term Structure, the Theory of Asset Pricing, decision-making under uncertainty: risk and insurance.

Module 3: Sustainability Study of a Project, Budget plan, estimation of the project cost, prices, fees and cost recovery, financing of recurrent costs, sustainability of the activities generated by the project.

Module 4: Economic Feasibility Study, Problem of pricing under oligopoly, problem of market stagnation, problem of volatility in open economy, problem of global meltdown, problem of financing a project.

Module 5: Facets of project viability – commercial, technical, financial, outline of a model project report, a real life case study.

Text Books:

1. R. Panneersalvam, *Engineering Economics*, 2nd Ed., Prentice Hall of India, 2014.
2. James Riggs, *Engineering Economics*, 4th Ed., McGraw Hill Education, 2004.

Reference Books:

1. Donald G. Newnan, Ted G. Eschenbach and Jerome P. Lavelle, *Engineering Economic Analysis*, 13th Ed., Oxford University Press, 2017.
2. Chan S. Park, *Contemporary Engineering Economics*, 6th Ed., Pearson, 2015.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	HSSM –IV (Economics for Engineers)	Course Code:	ECO11505

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO2	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO3	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO4	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO5	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO6	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
Average	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3

Internet of Medical Things (IoMT)

BME 11030	PE –III **Internet of Medical Things (IoMT)**	L	T	P	C
Version 1.0	**Contact Hours – 45**	3	0	0	3
Pre-requisites/Exposure	12th level Mathematics				
Co-requisites					

Course Objectives:

- To introduce the fundamentals of the Internet of Medical Things (IoMT) and its role in digital healthcare.
- To understand the architecture, components, and communication protocols of IoMT systems.
- To explore wearable and implantable medical devices and their integration in smart healthcare environments.
- To examine the use of AI, big data, and analytics in disease diagnosis and personalized medicine.
- To study remote patient monitoring systems, smart hospitals, and IoT-enabled medical imaging.
- To understand data privacy, security standards, and ethical issues related to IoMT, including HIPAA and GDPR compliance.
- To explore advancements in biomedical robotics, digital twin technology, and autonomous medical systems.
- To encourage innovation by designing prototypes and analyzing trends in IoMT startups and healthcare markets.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand the foundational architecture of IoMT systems, including medical device communication standards, network protocols, and cloud-edge computing for healthcare data exchange.

CO2. Evaluate the features and applications of wearable, implantable, and IoT-enabled medical devices in remote health monitoring, clinical diagnostics, and smart hospital ecosystems.

CO3. Implement AI, big data, and analytics in healthcare contexts to facilitate predictive diagnostics, personalized treatment plans, and data-driven insights within IoMT

infrastructures.

CO4. Design and prototype innovative IoMT solutions, incorporating sensor integration, real-time data acquisition, and emerging digital health technologies for smart and connected healthcare systems.

CO5. Explore future-oriented healthcare trends, such as biomedical robotics, digital twins, and AI-powered urban health infrastructure, within the evolving landscape of digital medicine.

CO6. Critically assess privacy, ethical, and cybersecurity dimensions of IoMT platforms, with emphasis on encryption practices, regulatory frameworks (e.g., HIPAA, GDPR), and secure-by-design principles.

Course Description:

This course explores the fundamentals and applications of the Internet of Medical Things (IoMT) in digital healthcare. It covers IoT architecture, wearable and implantable devices, wireless communication protocols, and smart hospital systems. Students will learn to integrate AI, big data analytics, and cloud technologies for disease diagnosis, remote monitoring, and personalized medicine. The course also addresses cybersecurity, data privacy, ethical considerations, biomedical robotics, and emerging trends like digital twins and healthcare startups.

Course Content

Module 1: Introduction to IoMT & Digital Healthcare, Core Components of IoMT: Devices, Sensors, Cloud, AI, IoT Architecture & Medical Device Connectivity, Basics of IoT Networks & Communication Protocols, Cloud Computing & Edge Computing in IoMT, Data Transmission Standards (Bluetooth, Wi-Fi, NFC, LoRaWAN).

Module 2: Wearable & Implantable Medical Devices, Wireless Body Area Networks (WBANs), Remote Patient Monitoring (RPM) & Smart Hospitals, Smart Beds, Automated Drug Dispensers, IoT-enabled Medical Imaging Systems, Case Studies on Wearable Health Technologies.

Module 3: AI & Data Analytics in IoMT, AI-based Disease Diagnosis & Risk Assessment, Big Data Processing in Healthcare, Personalized Medicine & AI-driven Drug Discovery.

Module 4: Security, Privacy & Ethical Considerations in IoMT, HIPAA & GDPR Compliance for IoMT Data, Encryption Techniques & Secure Data Transmission, Ethical Issues in AI & IoT Healthcare.

Module 5: Biomedical Robotics & Autonomous Medical Systems, Future Trends & Innovations in IoMT, Digital Twin Technology for Healthcare, Smart Cities & Healthcare Infrastructure, Building a Prototype IoMT System, IoMT Startup Trends & Market Analysis

Books:

Internet of Things in Healthcare: Concepts, Technologies, and Applications *by* Rahul C. M., Vivek R.

Internet of Things for Healthcare Technologies *Editors:* Chinmay Chakraborty, Suman Kumar, Al-Sakib Khan Pathan

Healthcare Paradigms in the Internet of Things Ecosystem by Valentina E. Balas, Lakshmanan Muthuramalingam

Artificial Intelligence in Healthcare *by* Adam Bohr, Kaveh Memarzadeh

Biomedical Signal and Image Processing with Artificial Intelligence by Nilanjan Dey, Amira Ashour
Biomedical Robotics by Jacob Rosen (Handbook of Biomedical Robotics)

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	PEC –III **Internet of Medical Things (IoMT)**	Course	BME 11030

Code:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	3	2	3	1	0	0	2	0	0	0	1	2	3
CO2	3	2	3	3	3	2	0	0	3	1	1	1	2	3	3
CO3	1	2	3	3	3	1	0	0	2	0	1	0	2	3	3
CO4	1	2	3	3	3	1	0	0	2	0	1	0	2	3	3
CO5	3	3	3	3	3	1	0	0	2	1	2	2	2	3	3
CO6	2	2	2	1	0	2	0	3	2	0	3	2	1	2	2
Averag e	2.1 6	2.1 6	2.8	2.5	3	1.3	0	3	2.1 6	1	1.6	1.6	1.6	2.6	2.8

Drug delivery system

BME 11031	PE –III **Drug delivery system**	L	T	P	C
Version 1.0	**Contact Hours – 45**	3	0	0	3
Pre-requisites/Exposure	Chemistry, physics				
Co-requisites					

Course Objectives:

- To introduce the principles of drug delivery systems and pharmacokinetics (ADME).
- To understand various conventional and modern drug delivery routes such as oral, parenteral, transdermal, and inhalation.
- To explore controlled, sustained, and targeted drug delivery methods for enhanced therapeutic efficiency.
- To study the role of nanotechnology and biomaterials in developing advanced drug carriers and smart delivery systems.
- To understand cellular uptake, drug transport barriers (e.g., blood-brain barrier), and strategies to enhance bioavailability.
- To explore innovative technologies such as AI, machine learning, and 3D printing in drug formulation and personalized medicine.
- To gain knowledge of regulatory frameworks, clinical trial processes, and real-world drug approval case studies.

Course Outcomes

On completion of this course, the students will be able to

CO1. Demonstrate a strong foundation in pharmacokinetics and various drug administration routes—oral, parenteral, transdermal, and inhalation—to inform therapeutic strategy and dosing design.

CO2. Analyze controlled and sustained drug release systems, focusing on site-specific and targeted delivery mechanisms that enhance treatment efficacy and patient compliance.

CO3. Apply concepts of nanotechnology and biomaterials to develop novel drug carriers, including liposomes, polymeric nanoparticles, micelles, and biodegradable implants for advanced medical use.

CO4. Evaluate formulation strategies aimed at improving bioavailability and overcoming biological barriers, incorporating cutting-edge tools such as AI, machine learning, and 3D printing.

CO5. Explore the process of translating laboratory research into clinical applications, including preclinical studies, product development, and real-world case evaluations.

CO6. Interpret and compare international regulatory frameworks (e.g., FDA, EMA, WHO) governing drug delivery systems, with emphasis on ethical considerations and approval pathways.

Course Description:

This course provides an in-depth understanding of drug delivery principles, including pharmacokinetics, conventional and advanced delivery routes, and controlled-release formulations. It explores nanotechnology-based carriers, biomaterials, and smart delivery systems for targeted and sustained release. Students will also learn about cellular uptake mechanisms, strategies to enhance bioavailability, and emerging technologies like AI, 3D printing, and wireless systems in personalized medicine, along with regulatory and clinical considerations.

Course Content

Module 1: Introduction to Drug Delivery Systems, Fundamentals of drug delivery, Pharmacokinetics (Absorption, Distribution, Metabolism, Excretion), Conventional Drug Delivery Methods, Oral drug delivery (Tablets, Capsules, Liquids), Parenteral drug delivery

(Intravenous, Subcutaneous, Intramuscular), Transdermal patches and topical applications, Inhalation drug delivery systems.

Module 2: Controlled and Sustained Drug Release, Types of controlled release systems (Matrix, Reservoir, Diffusion-based),Targeted Drug Delivery & Site-Specific Therapeutics, Ligand-based targeting strategies, Bioengineering approaches for precision medicine, Case studies on sustained-release formulations.

Module 3: Nanotechnology in Drug Delivery, Liposomes & polymeric nanocarriers, Smart drug delivery systems using nanotechnology, Biodegradable & Biomaterial-Based Drug Carriers, Biodegradable implants & injectable systems.

Module 4: Cellular drug uptake mechanisms, Blood-brain barrier & strategies for drug penetration, Enhancing bioavailability through formulation design, AI & machine learning in drug formulation, 3D printing in personalized medicine.

Module 5: Regulatory Considerations & Clinical Trials, FDA, EMA, and WHO regulations for drug formulations, Case studies on successful drug approval processes, Wireless drug delivery systems.

Books:

1. **Drug Delivery and Targeting: For Pharmacists and Pharmaceutical Scientists** by Anya M. Hillery, Andrew W. Lloyd, James Swarbrick

2. **Modern Pharmaceutics** by Alexander T. Florence & Juergen Siepmann
3. **Controlled Drug Delivery: Fundamentals and Applications by** Joseph R. Robinson & Vincent H. L. Lee
4. **Targeted Drug Delivery: Concepts and Design** *Editors:* Padma V. Devarajan, Sandip B. Patel
5. **Nanoparticulate Drug Delivery Systems** *Editor:* Deepak Thassu
6. Pharmaceutical Quality by Design: A Practical Approach *Editors:* Walkiria S. Schlindwein, Mark Gibson
7. **Drug Delivery: Principles and Applications by** Binghe Wang, Teruna J. Siahaan, Richard A. Soltero

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	PE –III **Drug delivery system**	Course Code:	BME 11031

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	2	2	1	1	1	2	1	2	3	2	1
CO2	3	3	3	2	2	3	2	2	2	3	2	3	3	3	2
CO3	3	3	3	2	3	3	2	1	2	3	3	2	3	3	3
CO4	3	3	3	3	3	3	2	1	2	3	2	3	3	3	2
CO5	2	2	3	3	2	2	3	1	2	2	2	3	3	2	2
CO6	3	3	2	2	2	2	1	3	2	3	3	3	3	3	2
Average	2.8	2.1	2.6	2.1	2.3	2.4	1.6	1.5	1.8	2.6	2.1	2.6	3	2.6	2

Laser and fiber optics in medicine

BME 11032	PE –III **Laser and fiber optics in medicine**	L	T	P	C
Version 1.0	**Contact Hours – 45**	3	0	0	3
Pre-requisites/Exposure	Chemistry, physics				
Co-requisites					

Course Objectives:

- Understand the fundamentals of radiofrequency and its biomedical applications.
- Explore the principles of medical lasers and their interaction with biological tissues.
- Learn the basics of fiber optic technology and its role in medical diagnostics and therapy.
- Study various imaging and therapeutic applications like OCT, PDT, and endoscopy.
- Analyze safety protocols and international regulations for clinical laser use.
- Examine current trends including AI, quantum optics, and 3D laser imaging in precision medicine.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand the fundamental principles of radiofrequency (RF) and electromagnetic wave propagation in biological tissues, and assess the performance and safety of RF-based biomedical devices such as wearable monitors and biosensors.

CO2. Explain the mechanisms of laser-tissue interactions and distinguish various types of medical lasers by their operational wavelengths, energy delivery modes, and clinical applications.

CO3. Apply fiber optic technologies for medical diagnostics and therapeutic procedures, including their use in endoscopy, spectroscopic analysis, and targeted light-based drug delivery.

CO4. Evaluate advanced laser-assisted modalities, such as Optical Coherence Tomography (OCT), photodynamic therapy, low-level laser therapy (LLLT), and confocal microscopy, focusing on their diagnostic precision and therapeutic potential.

CO5. Analyze safety standards and regulatory frameworks governing the use of biomedical lasers, with emphasis on operational protocols, risk mitigation, and international compliance.

CO6. Explore emerging innovations in laser and photonics-based medicine, including AI-enhanced diagnostics, quantum optics, holographic imaging, and 3D laser applications shaping the future of minimally invasive healthcare.

Course Description:

This course introduces the principles and biomedical applications of radiofrequency, lasers, and fiber optics. It covers electromagnetic wave interactions with tissues, laser-tissue

interactions, and fiber optic technologies in diagnostics, imaging, and therapy. Emphasis is placed on clinical applications like laser surgery, OCT, PDT, and endoscopy, along with safety standards, regulatory frameworks, and emerging trends such as AI-assisted diagnostics and quantum optics.

Course Content

Module 1: Introduction to radiofrequency, Basics of electromagnetic waves, Wave propagation in biological tissues, RF Instrumentation and Components, Safety standards and shielding, Biomedical Applications of RF in wearable health monitors and powered biosensors

Module 2: Introduction to Laser & Fiber Optics in Medicine, Interaction of light with biological tissues, Principles of Lasers in Medicine, Types of medical lasers (CO_2, Nd:YAG, Diode, Excimer), Laser power, intensity, and wavelength considerations.

Module 3: Fundamentals of fiber optic technology, Optical fibers for medical imaging and diagnostics, Light-guided drug delivery systems, Laser Applications in Surgery, Minimally invasive laser procedures (Ophthalmology, Dermatology), Case studies in laser-guided surgeries.

Module 4: Optical coherence tomography (OCT), Laser fluorescence imaging, Fiber optic endoscopy and spectroscopy, Confocal laser scanning microscopy, Photodynamic therapy (PDT), Low-level laser therapy (LLLT) and tissue healing.

Module 5: Safety & Regulations in Medical Lasers, Laser hazard classification and safety protocols, Regulations for laser use in healthcare (FDA, IEC standards), AI-assisted laser diagnostics, Quantum optics in medical applications, Holographic and 3D imaging using lasers, Future advancements in laser-based precision medicine.

Books:

- **"Lasers in Medicine"** by Ronald W. Waynant and Darrell B. Tata
- **"Medical Applications of Lasers"** by David J. Apfelberg
- **"Biomedical Optics: Principles and Imaging"** by Lihong V. Wang and Hsin-i Wu
- **"Laser-Tissue Interactions"** by Markolf H. Niemz
- **"Optical-Thermal Response of Laser-Irradiated Tissue"** by Ashley J. Welch and Martin J.C. van Gemert

- **"Introduction to Biomedical Engineering"** by John Enderle, Joseph Bronzino
- **"Fiber Optics in Biomedical Applications"** by Israel Gannot

- **"Fundamentals of Photonics"** by Bahaa E.A. Saleh and Malvin Carl Teich (for foundational optics)

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: PE –III **Laser and fiber optics in medicine** Course Code: BME 11032

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	3	2	1	0	0	2	0	2	3	3	2
CO2	3	3	3	2	2	2	1	0	0	2	0	2	3	3	3
CO3	3	3	3	3	3	2	1	0	0	2	0	3	3	3	3
CO4	3	3	3	3	3	2	1	0	0	3	0	3	3	3	3
CO5	2	2	2	2	2	3	2	3	0	3	0	2	3	2	2
CO6	3	3	3	3	3	2	2	2	0	3	2	3	3	3	3
Average	2.8	2.8	2.6	2.5	2.6	2.1	1.6	2.5	0	2.5	2	2.5	3	2.8	2.6

Rehabcare Engineering

BME11033	Prof. Elective- IV (Rehabcare Engineering)	L	T	P	C

Version 1.0	**Contact Hours - 45**	3	0	0	3
Pre-requisites/Exposure	Not required				
Co-requisites	--				

Course Objectives

1. Apply measurement concepts and biomechanical principles to measure and analyze human movement in order to calculate forces, accelerations, etc., acting on or associated with specific joints or limbs.
2. Analyze stress/strain experienced by body parts and prosthetic elements, and evaluate related safety factors.
3. Work as part of a team to complete a multi-week research project and share the results of their research through an oral presentation.
4. Identify and discuss key elements and issues of rehabilitative/assistive technologies.

Course Outcomes

On completion of this course, the students will be able to

CO1. Explain the design and functional principles of prosthetic and orthotic devices, including materials, biomechanical concepts like three-point pressure, and applications in various levels of limb amputation.

CO2. Assess and describe assistive auditory and speech technologies, such as hearing aids, cochlear implants, and voice synthesizers, with emphasis on signal processing applications.

CO3. Identify and evaluate visual impairment aids, including ultrasonic and laser canes, intraocular lenses, Braille readers, and screen reader systems for enhancing accessibility.

CO4. Analyze muscular impairments and their management through the use of medical stimulators, exploring conditions like muscular dystrophies, paraplegia, and quadriplegia.

CO5. Apply therapeutic principles and treatment approaches to address common deformities of the limbs and spine, using clinical strategies tailored to severity levels.

CO6. Integrate knowledge of assistive and rehabilitative technologies to support Activities of Daily Living (ADLs), enhancing patient functionality and independence.

Course Description

Introduction to technologies used for rehabilitation and improved function, including limb and spinal orthoses and prostheses, gait analysis, sensory aids, and augmentation

Course Content

Module 1: Prosthetic and Orthotic Devices: Causes of Amputation, Types of Amputation, and levels of amputation for upper and lower Extremity, Hand and arm replacement, different types of models for externally powered limb prosthetics, lower limb, upper limb orthotics, spinal orthotics; Endo and Exo-skeletal Prosthetics; materials used for prosthetic and orthotic devices, mobility aids. Principles of three point pressure, total contact, partial weight bearing, Activities of Daily Living: ADL grouping, Barthel's Index of ADL.

Module 2: Auditory And Speech Assist Devices: Types of deafness, hearing aids, application of DSP in hearing aids, Cochlear implants, Voice synthesizer, speech trainer.

Module 3: Visual Aids: Causes of visual impairments; Ultra sonic and laser canes, Intra ocular lens, Braille Reader, Tactile devices for visually challenged, Text voice converter, screen readers.

Module 4: Muscle impairments and Medical Stimulator: Muscular impairments: Muscular Dystrophy, Duchenne Muscular Dystrophy, Facioscapulohumeral Muscular Dystrophy, Paraplegia, Quadriplegia: Etiology, Mechanism of injury and management. Muscle and nerve stimulator, Location for Stimulation, Functional Electrical Stimulation, Sensory Assist Devices, Design issues.

Module 5: Therapies for deformities and muscular impairments: Types of deformities; Management of 1st and 2nd degree deformities; Common deformities of lower limb, partial foot deformities, Deformities of the foot, Arm deformities, Torticollis.

Text Book(s):

1. Rory A Cooper; An Introduction to Rehabilitation Engineering; CRC press; 2006
2. Albert M.Cook and JG Webster; Therapeutic Medical devices; Prentice Hall Inc., NewJersy; 1982.

Reference Book(s):

1. Joseph D. Bronzino; The Biomedical Engineering Handbook; 3rd Edition; Three Volume Set; CRC Press; 2006.
2. Ed: S.N. Levine; Advances in Bio Medical Engineering and Medical Physics; Inter University Publication, New York; 1968.
3. J Reswick; What is Rehabilitation Engineering, Annual review of Rehabilitation; Volume: 2, Springer-Verlag, New York; 1982.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Elective- IV (Rehabcare Engineering)	Course Code:	BME11033

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO2	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO3	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO4	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO5	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO6	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
Averag e	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3

Biofabrication

BME11034	**Prof. Elective- IV Biofabrication**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hours - 45**	3	0	0	3
Pre-requisites/Exposure	Not required				
Co-requisites	--				

Course Objective:

- To introduce the principles and techniques of biofabrication and their applications in tissue engineering and regenerative medicine.
- To familiarize students with 3D bioprinting, biomaterials, organ-on-chip systems, and scaffold design strategies.
- To build competency in evaluating clinical translation, ethical, and regulatory considerations in biofabrication technologies.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand the foundational concepts of biofabrication and tissue engineering, including biomaterial properties, biodegradation mechanisms, and their integration in regenerative medicine strategies.

CO2. Analyze biomaterial selection and scaffold design approaches, focusing on biocompatibility, mechanical properties, and degradation profiles suitable for engineered tissue constructs.

CO3. Demonstrate proficiency in 3D bioprinting technologies, encompassing bioink formulation, cell encapsulation, and advanced crosslinking methods for creating functional and viable tissue models.

CO4. Apply microfluidic and organ-on-a-chip platforms to mimic physiological environments for disease modeling, drug screening, and scaffold-based tissue regeneration.

CO5. Assess translational applications of biofabrication, including computational modeling, clinical implementation, and engineering of complex tissues like vasculature, bone, and

neural interfaces.

CO6. Evaluate ethical, regulatory, and entrepreneurial perspectives, including compliance with FDA/EMA standards, commercialization strategies, and the evolving landscape of biofabrication startups.

Course Description:

This course provides a comprehensive overview of biofabrication, focusing on biomaterials, 3D bioprinting, and microfluidic technologies for engineering functional tissue constructs. It covers design strategies for scaffolds, development of responsive bioinks, and simulation of physiological environments using organ-on-chip systems. Students will also explore the translational, ethical, and regulatory aspects of deploying biofabricated tissues in clinical settings and commercial ventures.

Course Content

Module 1: Introduction to Biofabrication, Principles of tissue engineering and regenerative medicine, Overview of biofabrication techniques, Biomaterials for Biofabrication, Biodegradation and material stability.

Module 2: Bioprinting Technologies, 3D bioprinting principles and techniques, Case studies on 3D-printed tissues, Bioinks and Cell Encapsulation, Crosslinking mechanisms for bioink stabilization, Advances in smart and responsive bioinks.

Module 3: Microfluidics and Organ-on-a-Chip Technologies, Simulation of cellular microenvironments, Applications in drug testing and disease modeling, Design principles for biomimetic scaffolds, Case studies on scaffold-based tissue repair.

Module 4: Biofabrication for Regenerative Medicine, Applications in bone, cartilage, and skin engineering, Bioprinted vascular and neural structures, Translational aspects of biofabrication in clinical settings, Computational Modeling in Biofabrication, Finite element modeling in bioprinting.

Module 5: Ethical and Regulatory Considerations, FDA and EMA regulations on biofabricated tissues, Bioprinting ethical concerns and challenges, Commercialization and startup opportunities in biofabrication.

Books

1. **"Biofabrication"** by Gabor Forgacs and Wei Sun

2. **"3D Bioprinting: Principles and Protocols"** – Edited by Chee Kai Chua, Wai Yee Yeong

3. **"Essentials of 3D Biofabrication and Translation"** – Edited by Anthony Atala & James Yoo

4. **"Tissue Engineering"** by Bernhard O. Palsson and Sangeeta N. Bhatia
5. **Organ-on-a-Chip: Engineered Microenvironments for Safety and Efficacy Testing"** – Edited by Yu-suke Torisawa

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: Prof. Elective- IV **Biofabrication** Course Code: BME11034

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	2	0	2	0	0	0	0	2	3	3	2
CO2	3	3	3	3	3	0	2	0	0	0	0	3	3	3	3
CO3	3	3	3	3	3	0	2	0	0	2	0	3	3	3	3
CO4	3	3	3	3	3	0	2	0	0	2	0	3	3	3	3
CO5	3	3	3	3	3	2	2	0	0	2	0	3	3	3	3
CO6	2	2	2	2	2	3	3	3	0	3	3	3	2	3	2
Average	2.8	2.8	2.6	2.6	2.6	2.5	2.1	3	2.2	2.2	3	2.8	2.8	3	2.6

BioMEMS and Biomicrofluidics

BME11035	Prof. Elective- IV BioMEMS and Biomicrofluidics	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	Not required				
Co-requisites	--				

Course Objectives:

- To understand the fundamental principles and microfabrication techniques used in BioMEMS.
- To explore the physics of fluid flow at microscale and its application in biomedical diagnostics.
- To learn design and operation of microfluidic systems for drug delivery, biosensing, and tissue engineering.
- To assess regulatory frameworks and commercialization pathways for BioMEMS innovations.
- To explore cutting-edge trends such as soft robotics, AI in diagnostics, and nanoBioMEMS.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand the core principles of BioMEMS and biomicrofluidics, focusing on microfabrication methods, materials selection, and surface modification techniques in biomedical engineering.

CO2. Analyze microscale fluid behavior and mixing phenomena, and evaluate design parameters of microfluidic devices used in biosensing, point-of-care testing, and lab-on-a-chip platforms.

CO3. Apply microfluidic technologies in targeted drug delivery, micropump development, and scaffold-based tissue engineering, with applications in regenerative medicine and oncology.

CO4. Assess a range of biosensing applications in BioMEMS—including wearable and implantable systems, AI-integrated sensors, and the evolution of nanoBioMEMS for real-time

diagnostics.

CO5. Evaluate regulatory frameworks and commercialization strategies, considering intellectual property rights, FDA/CE approval processes, and translational barriers for BioMEMS innovations.

CO6. Explore emerging trends and future directions in BioMEMS and biomicrofluidics, such as soft robotics, 3D-printed microdevices, and integrated biochip platforms for precision healthcare.

Course Description:

This course introduces students to the interdisciplinary field of **Biomedical Microelectromechanical Systems (BioMEMS)** and **Biomicrofluidics**, exploring their roles in diagnostics, drug delivery, biosensing, and regenerative medicine. It focuses on microfabrication techniques, fluid dynamics at microscale, biomaterials, and their real-world applications in wearable/implantable medical devices. The course also discusses commercialization strategies and emerging trends in nanoBioMEMS and lab-on-a-chip platforms.

Course Content

Module 1: Introduction to BioMEMS &Biomicrofluidics, Applications in diagnostics, drug delivery, and biosensing, Microfabrication Techniques for BioMEMS, Lithography and microfabrication processes, Materials for BioMEMS (Silicon, Polymers, Hydrogels), Surface functionalization and bioengineering.

Module 2: Fluid Dynamics in Biomicrofluidics, Reynolds number and laminar vs. turbulent flow, Microfluidic mixing and diffusion mechanisms, Bio-inspired fluidic designs, Microfluidic biosensors for disease detection, Point-of-care diagnostics using microfluidics.

Module 3: Drug Delivery & Micropumps, Microfluidic approaches in controlled drug delivery, Micropumps and actuators in BioMEMS systems,Microfluidic bioreactors for cell cultures, BioMEMS-assisted regenerative medicine, Case studies on cancer therapy using microfluidics.

Module 4: Biosensors & Microfluidic Detection Systems, Microfluidic detection of biomolecules (DNA, proteins), Wearable and implantable biosensing systems, AI-enhanced bioMEMS diagnostics, Microfluidics-assisted nanoparticle synthesis, Future trends in nanoBioMEMS.

Module 5: Commercialization & Regulatory Aspects of BioMEMS, FDA and regulatory standards for BioMEMS devices, Intellectual property & patents in BioMEMS, Market trends and commercialization challenges, Case studies on successful BioMEMS startups.

Books

1. "Introduction to BioMEMS" – Albert Folch
2. "BioMEMS: Science and Engineering Perspectives" – Simona Badilescu & Lucian Barbu-Tudoran
3. "Biomedical Microsystems" – Ellis Meng
4. "Lab-on-a-Chip Technology" – Edited by Keith E. Herold & Avraham Rasooly
5. "Fundamentals and Applications of Microfluidics" – Nam-Trung Nguyen & Steven Wereley

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Elective- IV **BioMEMS and Biomicrofluidics**	Course Code:	BME11035

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	0	0	0	0	2	0	1	3	2	2
CO2	3	3	3	2	2	1	0	0	0	2	1	2	3	3	2
CO3	3	3	3	3	3	1	0	0	0	2	0	2	3	3	3
CO4	3	2	3	3	3	2	0	0	1	2	1	2	3	3	3
CO5	2	2	1	1	1	2	2	3	3	3	2	3	2	2	2
CO6	2	2	2	3	3	3	2	2	2	2	3	3	3	3	3
Average	2.6	2.3	2.3	2.16	2.16	1.8	2	2.5	2	2.16	1.75	2.16	2.8	2.6	2.5

Radiotherapy and Nuclear Medicine

BME11036	Open Elective- I Radiotherapy and Nuclear Medicine	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	Physics, chemistry, biology				
Co-requisites	--				

Course Objectives:

- To understand the physics, dosimetry, and biological effects of ionizing radiation.
- To explore various radiotherapy techniques and their clinical applications.
- To examine nuclear medicine modalities like PET and SPECT.
- To learn about the design, development, and safety of radiopharmaceuticals.
- To analyze advanced radiotherapy systems including IGRT and AI-driven approaches.
- To assess regulatory, ethical, and translational aspects in radiation medicine.

Course Outcomes

On completion of this course, the students will be able to

CO1. Demonstrate foundational knowledge of radiation physics and dosimetry, including the biological interactions of ionizing radiation with tissues and their implications in diagnostics and therapeutic contexts.

CO2. Apply principles of modern radiotherapy techniques—such as IMRT, EBRT, stereotactic radiosurgery, and brachytherapy—to develop and evaluate precision treatment planning strategies.

CO3. Explain nuclear imaging modalities like PET and SPECT, with a focus on radioisotope pharmacokinetics and their diagnostic significance in oncology, cardiology, and neurology.

CO4. Evaluate the design, efficacy, and safety of radiopharmaceuticals, including traditional and next-generation radiotracers tailored for both imaging and therapeutic purposes.

CO5. Critically assess innovations in image-guided radiotherapy, such as IGRT, adaptive planning, and AI-assisted delivery systems, for improving treatment accuracy and outcomes.

CO6. Explore emerging trends and regulatory frameworks in radiation medicine, emphasizing safety protocols, clinical translation, and global standards for ethical practice in radiation-based therapies.

Course Description:

This course offers a comprehensive overview of **radiotherapy** and **nuclear medicine**, covering the physics of radiation, advanced treatment modalities, and the clinical application of radiopharmaceuticals. It emphasizes both diagnostic and therapeutic aspects, from PET/SPECT imaging to IMRT and AI-assisted radiotherapy. Students will gain insight into biological interactions of ionizing radiation, safety protocols, and emerging innovations in image-guided therapy and nuclear diagnostics.

Course Content

Module 1: Introduction to Radiotherapy & Nuclear Medicine, Basics of radiation physics, Applications in oncology and diagnostic imaging, Radiation Physics & Dosimetry, Fundamentals of ionizing radiation, Radiation dose measurement and dosimetry techniques, Biological effects of radiation on human cells.

Module 2: Radiotherapy Techniques & Applications, External beam radiotherapy (EBRT), Intensity-modulated radiotherapy (IMRT), Stereotactic radiosurgery (CyberKnife, Gamma Knife), Brachytherapy and radioactive implants.

Module 3: Nuclear Medicine & Imaging Modalities, Principles of nuclear imaging and functional imaging, Positron Emission Tomography (PET) & Single Photon Emission Computed Tomography (SPECT), Radioisotopes used in medical imaging, Applications in cardiology, neurology, and oncology.

Module 4: Radiopharmaceuticals & Drug Development, Introduction to radiopharmaceuticals, Radioactive tracers and their biological mechanisms, Production and safety of radiopharmaceuticals, Emerging trends in radiotracer design.

Module 5: Image-Guided Therapy & Advanced Techniques, Image-guided radiotherapy (IGRT), Adaptive radiotherapy techniques, Artificial intelligence in radiation oncology, Future trends in nuclear imaging.

Books:

1. **"Radiation Therapy Physics"** – William R. Hendee & Geoffrey S. Ibbott
   – *Good for radiation physics and dosimetry concepts.*
2. **"Principles and Practice of Radiation Oncology"** – Carlos A. Perez & Luther W. Brady
   – *Comprehensive text for radiotherapy techniques.*

3. **"Physics in Nuclear Medicine"** – Simon R. Cherry, James A. Sorenson, Michael E. Phelps
   – Covers PET/SPECT and radioisotope imaging in detail.
4. **"Nuclear Medicine: The Requisites"** – Harvey A. Ziessman, Janis P. O'Malley
   – Useful for clinical applications and diagnostics in nuclear medicine.
5. **"Radiopharmaceuticals in Nuclear Pharmacy and Nuclear Medicine"** – Richard J. Kowalsky & Steven W. Falen

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Open Elective- I **Radiotherapy and Nuclear Medicine**	Course Code:	BME11036

CO/PO	PO 1	PO 2	PO 3	PO4	PO5	PO 6	PO 7	PO8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	1	0	1	0	0	2	0	1	3	2	2
CO2	3	3	3	2	2	1	1	0	0	2	1	2	3	3	2
CO3	3	2	3	3	2	0	0	0	0	2	1	2	3	3	2
CO4	3	2	3	2	3	2	0	0	1	2	0	2	3	3	3
CO5	3	3	3	3	3	2	0	0	2	3	1	2	3	3	3
CO6	2	2	2	2	2	3	3	3	2	2	3	3	2	3	3
Averag e	2.8	2.3	2.6	2.1 6	2.1 6	2	1.6	3	1.6	2.16	1.5	2	2.8	2.6	2.6

Biological Control Systems Lab

BME12037	PC XII Lab- Biological Control Systems Lab	L	T	P	C
Version 1.0	Contact Hours - 30	0	0	2	1
Pre-requisites/Exposure	Physics, chemistry, biology				
Co-requisites	--				

Course Objectives:

- To introduce the principles of feedback and control mechanisms in biological systems.
- To enable simulation of physiological processes like homeostasis, heart rate, respiration, and hormone regulation.
- To develop computational models of neural and biomechanical control for human motion.
- To analyze biosignals such as EEG and EMG using control system concepts.
- To explore AI and machine learning tools for predictive modeling in biological systems.
- To simulate pharmacokinetic models and assess personalized drug delivery control.
- To understand disease progression and immune response through control system modeling.

Course Outcomes

On completion of this course, the students will be able to

CO1: Model and simulate biological feedback control systems such as homeostasis and physiological regulation using mathematical and computational tools.

CO2: Develop and evaluate neural control models including reflex arcs, sensory feedback, and neuroprosthetic interfaces for signal processing and control.
CO3: Simulate and assess respiratory system control, lung mechanics, and gas exchange using spirometry data and computational tools.

CO4: Model hormonal feedback loops such as insulin-glucose and thyroid regulation, and analyze the endocrine system's dynamic control mechanisms.

CO5: Simulate pharmacokinetics and drug delivery models, and apply AI techniques for predictive modeling in personalized medicine.

CO6: Model biomechanical systems including gait, posture, and musculoskeletal control using biological feedback and neural control theories.

Course Description:

This lab course provides hands-on experience in modeling and simulating biological control systems such as cardiovascular, neural, respiratory, and endocrine regulation using computational tools. It integrates concepts of physiological feedback, biosignal analysis, drug delivery, and AI applications to understand dynamic control in living systems.

Course Content

List of Experiments:

1. Introduction to Biological Control Systems - Understanding feedback loops in biological regulation, Mathematical modeling of physiological systems, Simulation of homeostasis and adaptive control.

2. Analysis of Cardiovascular Control Systems - Modeling heart rate regulation and baroreceptor response, Blood pressure control using feedback mechanisms, Simulation of circulatory system dynamics.
3. Neural Control and Signal Processing - Computational modeling of neural pathways, Simulation of reflex arcs and sensory feedback loops, Brain-machine interfaces and neuroprosthetic control.

4. Respiratory System Control Mechanisms - Simulation of lung mechanics and gas exchange, Control of breathing rate under different physiological conditions, Analyzing spirometry data through computational models.

5. Endocrine Regulation and Hormonal Feedback - Modeling insulin-glucose regulatory systems, Simulation of thyroid hormone regulation and metabolic control, Computational analysis of hormonal oscillations

6. Drug Delivery and Pharmacokinetic Modeling - Simulating controlled drug release mechanisms, Pharmacodynamic responses to different dosing strategies, AI-driven predictive modeling for personalized medicine.

7. Biomechanical Control in Human Motion - Simulation of gait cycle and posture control, Modeling musculoskeletal interactions, Neural control of voluntary and involuntary movements.

8. Biosignal Processing and Control Applications - Analyzing EEG and EMG signals, Feature extraction and pattern recognition in biomedical signals, AI-based diagnostic applications using biosignals.

9. Disease Progression and Systemic Control - Computational modeling of tumor growth and cancer treatment, Simulation of immune system responses to infections, Analyzing disease spread models using control principles.

10. Future Trends in Biological Control Systems - AI and machine learning applications in physiological control, Wearable biosensor integration for remote health monitoring, Digital twin technology in personalized medicine

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: PC XII Lab **Biological Control Systems Lab** Course Code: BME12037

CO/PO	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	2	3	2	1	0	0	0	2	0	0	3	2	3
CO2	3	2	3	2	2	0	0	0	0	3	0	0	2	3	3
CO3	3	2	2	3	2	1	0	0	0	2	0	0	3	2	3
CO4	3	2	3	3	2	0	0	0	0	2	0	0	2	2	3
CO5	3	3	3	3	3	0	0	0	0	3	0	0	3	3	3
CO6	3	2	3	3	2	0	0	0	0	2	0	0	3	3	3
Averag e	3	2.3	2.6	2.8	2.1 6	1	0	0	0	2.3	0	0	2.6	2.5	3

Digital Image Processing Lab

BME12038	Prof. Core- XIII Lab (Digital Image Processing Lab)	L	T	P	C
Version 1.0	Contact Hours - 30	0	0	2	1
Pre-requisites/Exposure	Knowledge in Digital Electronics				
Co-requisites	--				

Course Objectives

1. To practice and get used to the basic image processing techniques.
2. To be able to understand and compute magnitude and phasor representation of images.
3. To understand the concepts of image restoration and segmentation.
4. To explore the applications of image processing techniques with MATLAB / C/ Labview/ similar software.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand and apply core image processing concepts, including histogram equalization, spatial filtering, and morphological operations.

CO2. Develop and implement spatial domain filtering techniques, such as smoothing, sharpening, and edge detection, to enhance and analyze digital images.

CO3. Perform morphological operations like erosion, dilation, opening, and closing to refine image structures and segment regions of interest.

CO4. Manipulate and process images programmatically, including loading, modifying, and reconstructing images using common image processing libraries.

CO5. Apply frequency domain techniques such as Discrete Cosine Transform (DCT) and its inverse (IDCT) to compress and reconstruct images.

CO6. Demonstrate problem-solving and coding skills by developing image analysis pipelines that address real-world scenarios using learned algorithms and techniques.

Course Description

For engineering courses, Mathematics is the backbone. Students will have good engineering

skills if their idea for Mathematics is clear. In this course, the focus will be on learning Mathematics in depth, which will motivate students to grow their thinking ability for Engineering also. By knowing the theory, a student will be able to apply that successfully to all kinds of problems in Engineering and science. Class participation is a fundamental aspect of this course. Students will be encouraged to participate actively in all group activities (Problem-solving, presentation, etc.).

Course Content

List of Experiments:

1. To study the Image Processing Concept

2. To obtain histogram equalization

3. To implement smoothing or averaging filter in spatial domain

4. Program for opening and closing the image.

5. To fill the region of interest for the image

6. Program for edge detection algorithm.

7. Program for sharpen image using gradient mask.

8. Program for morphological operation: erosion and dilation

9. Program for DCT/IDCT computation

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Prof. Core- XIII Lab Cours BME120

Name: (Digital Image Processing Lab) e Code: 38

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO3
CO1	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO2	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO3	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO4	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO5	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
CO6	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3
Averag e	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3

Internet of Medical Things Lab

BME12039	**Prof. elective- II Lab Internet of Medical Things Lab**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hours - 30**	0	0	2	1
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives:

- To understand the architecture and components of IoMT systems for digital healthcare.
- To interface biosensors and wearable devices for real-time health monitoring.
- To develop telemedicine and cloud-integrated remote patient monitoring applications.
- To apply AI and machine learning for healthcare data analysis and disease prediction.
- To implement secure data handling techniques including encryption and access control.
- To explore blockchain-based healthcare record management systems.
- To utilize wireless communication (Bluetooth, Wi-Fi, 5G) in IoMT connectivity.

- To evaluate emerging trends such as smart implants, robotic surgery, and edge computing in connected healthcare.

Course Outcomes

On completion of this course, the students will be able to

CO1. Design and configure IoMT architectures by integrating medical sensors, communication protocols, and data acquisition systems for connected healthcare environments.

CO2. Implement wearable and remote patient monitoring systems, utilizing biosensors, cloud technologies, and telemedicine frameworks to enable continuous health tracking.

CO3. Develop AI-driven healthcare applications by applying machine learning techniques to detect anomalies, predict diseases, and analyze patient data within IoMT networks.

CO4. Apply secure data handling and privacy protocols using encryption, access control mechanisms, and blockchain technologies to manage electronic health records and prevent breaches.

CO5. Analyze and process medical data, including imaging and sensor signals, for real-time diagnostics and healthcare decision support using AI and IoMT platforms.

CO6. Evaluate emerging technologies in digital healthcare, such as 5G, edge computing, robotic surgery, and smart implants, and assess their impact on future IoMT applications.

Course Description :

This lab course provides practical exposure to Internet of Medical Things (IoMT) technologies, including wearable sensors, remote monitoring, AI-based healthcare applications, secure data handling, and blockchain integration. Students will build intelligent healthcare systems using modern IoT platforms, medical data processing, and cutting-edge communication technologies like 5G and edge computing.

Course Content

List of Experiments:

1. Introduction to IoMT& Digital Healthcare - Setting up an IoMT network, Exploring IoMT architectures and protocols, Basics of medical sensor data acquisition

2. Wearable Health Devices & Biosensors - Interfacing heart rate and ECG sensors with IoMT systems, Glucose monitoring and wearable diabetes management, Temperature and oxygen saturation (SpO2) tracking.

3. Remote Patient Monitoring & Telemedicine - Implementing a real-time patient monitoring system, Wireless transmission of medical sensor data, Cloud integration for telemedicine applications.

4. Smart Hospital &IoMT-based Automation - IoMT-based smart bed and emergency alert system, RFID & NFC integration for hospital asset tracking, AI-based predictive analytics for patient care.

5. AI and Machine Learning in IoMT - Data analytics for disease prediction, AI-driven anomaly detection in patient data, Implementation of predictive healthcare models.

6. Medical Image Processing &IoMT - Image transmission and storage in connected healthcare, AI-based disease detection from medical images, Secure handling of patient imaging data.

7. Security & Privacy in IoMT - Data encryption techniques for medical IoT networks, Role-based access control in healthcare IoT, Cybersecurity challenges and risk mitigation strategies.

8. Blockchain&IoMT for Healthcare Data Management, Implementing a blockchain-based patient record system, Secure sharing of electronic health records (EHR), Decentralized authentication for IoMT devices.

9. Wireless Communication for IoMT Devices - Implementing Bluetooth and Wi-Fi-based health monitoring, IoT-enabled emergency response system, 5G and its role in IoMT connectivity.

10. Future Trends & Innovations in IoMT - AI-assisted robotic surgeries & remote healthcare interventions, Smart implants & bio-integrated IoT devices, Exploring the impact of 5G and edge computing in IoMT.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	**Prof. elective- II Lab Internet of Medical Things Lab**	Course Code:	BME12039

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2	0	0	2	2	2	2	3	3	3
CO2	3	2	3	2	3	2	0	0	2	2	2	2	3	3	3
CO3	3	3	3	3	3	1	0	0	0	2	2	3	3	3	3
CO4	2	2	2	2	3	3	0	2	0	2	2	3	3	3	3
CO5	3	3	3	3	3	2	0	0	0	2	2	3	3	3	3
CO6	3	2	3	2	3	3	2	0	0	2	2	3	3	3	3
Average	2.8	2.3	2.6	2.3	3	2.1	2	2	2	2	0	2.3	3	3	3

Drug delivery system Lab

BME12040	**Prof. elective- II Lab Drug delivery system Lab**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hours - 30**	0	0	2	1
Pre-requisites/Exposure	Knowledge in biomaterials, physiology, mathematics				
Co-requisites	--				

Course Objectives:

- To understand various drug delivery mechanisms including controlled, targeted, and stimuli-responsive systems.

- To formulate and characterize polymeric and lipid-based drug carriers.
- To perform in-vitro drug release and simulate pharmacokinetic models.
- To design nano/micro-scale delivery systems for targeted drug delivery.
- To explore innovative delivery platforms such as transdermal patches and hydrogel systems.
- To integrate AI, machine learning, and microfluidic technologies for smart drug delivery applications.

Course Outcomes

On completion of this course, the students will be able to

CO1. Explain and compare various drug delivery mechanisms, including controlled release systems, ADME principles, and the pharmacodynamic behavior of formulations.

CO2. Formulate and characterize advanced drug carriers, including polymeric and lipid-based systems, with emphasis on nanoparticle size, surface charge, and morphology affecting release kinetics.

CO3. Perform in-vitro drug release studies and simulate pharmacokinetic models such as zero-order, first-order, and Higuchi, to predict drug dissolution and clearance behavior.

CO4. Design nano and micro-scale drug delivery systems for targeted therapy, including encapsulation technologies and evaluation of cellular uptake in disease models.

CO5. Apply transdermal and stimuli-responsive delivery strategies, leveraging innovations in hydrogel, pH-sensitive, and magnetically triggered systems for optimized therapeutic outcomes.

CO6. Integrate AI, machine learning, and microfluidics to optimize drug formulation, delivery precision, and diagnostics through predictive modeling, lab-on-a-chip platforms, and smart biosensing tools.

Course Description:

This lab course introduces students to advanced drug delivery systems, focusing on formulation, characterization, pharmacokinetics, and emerging technologies. Emphasis is placed on nanoparticle-based carriers, in-vitro release studies, targeted therapies, and the integration of AI and microfluidics for precision medicine.

Course Content

List of Experiments:

1. Introduction to Drug Delivery Mechanisms - Understanding different drug delivery methods, Demonstration of controlled vs. uncontrolled drug release, Study of drug absorption, distribution, metabolism, and excretion (ADME).

2. Formulation and Characterization of Drug Carriers - Preparation of polymeric and lipid-based drug carriers, Characterization of nanoparticles for drug delivery (Size, Zeta Potential, Morphology), Effect of carrier properties on drug release kinetics

3. Pharmacokinetics and Drug Release Studies - Simulation of drug dissolution profiles, In-vitro drug release study using dialysis method, Mathematical modeling of drug release (Zero-order, First-order, Higuchi model).

4. Bioavailability and Pharmacodynamic Analysis - Comparison of oral vs. intravenous drug delivery, Evaluation of drug plasma concentration over time, Simulation of drug clearance rates in biological systems.

5. Nano and Micro Drug Delivery Systems - Fabrication of nanocarriers for targeted drug delivery, Encapsulation of bioactive molecules in microcapsules, Study of nanoparticle uptake in cell models.

6. Transdermal Drug Delivery and Patch Design - Preparation and testing of transdermal patches, Permeation study through synthetic skin models, Optimization of drug permeation enhancers.

7. Controlled and Stimuli-Responsive Drug Delivery - pH-sensitive drug release mechanisms, Temperature-responsive hydrogel drug carriers, Light and magnetically triggered drug delivery systems

8. Targeted Drug Delivery in Cancer Therapy - Ligand-based targeting strategies for tumor treatment, Cytotoxicity assay of drug-loaded nanoparticles, Evaluation of drug retention in tumor-like environments

9. BioMEMS and Microfluidics in Drug Administration - Microfluidic system for precision drug dosing, Lab-on-a-chip experiments for drug screening, Smart drug delivery systems using biosensors

10. AI and Machine Learning in Drug Delivery Optimization - Predictive modeling for personalized drug administration, AI-based optimization of drug formulations, Case studies on AI-driven drug discovery

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	**50**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	**Prof. elective- II Lab Drug delivery system Lab**	Course Code:	BME12040

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	2	2	1	0	0	2	0	3	3	3	2
CO2	3	3	3	3	3	0	0	0	2	2	0	2	3	3	3
CO3	3	3	3	3	2	0	0	0	0	1	0	3	2	3	3
CO4	3	2	3	2	3	2	0	1	2	2	0	3	3	3	3
CO5	3	2	3	2	3	1	2	0	0	1	0	3	3	3	3
CO6	3	3	3	3	3	1	1	0	0	2	2	3	3	3	3
Average	3	2.8	2.8	2.5	2.6	1.5	1.3	1	2	1.6	2	2.8	2.8	3	2.8

Laser and fiber optics in medicine Lab

BME12041	**Prof. elective- II Lab Laser and fiber optics in medicine Lab**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hours - 30**	0	0	2	1
Pre-requisites/Exposure	Physics, chemistry				

Co-requisites	--

Course Objectives:

- To understand the fundamentals of lasers and optical fibers in medical applications.
- To investigate laser-tissue interactions and implement laser safety protocols.
- To operate optical imaging systems like OCT for non-invasive diagnostics.
- To explore laser-assisted surgical and therapeutic techniques including LASIK, PDT, and LLLT.
- To design and assess fiber optic-based biosensors and imaging tools.
- To apply AI and machine learning for enhancing optical diagnostic and therapeutic systems.

Course Outcomes

On completion of this course, the students will be able to

CO1. Demonstrate an understanding of laser and optical fiber principles and their application in medical diagnostics, therapy, and tissue interaction.

CO2. Apply safety protocols and analyze biological effects of different laser-tissue interaction mechanisms including photothermal, photochemical, and photoablation processes.

CO3. Operate and interpret optical imaging systems, such as Optical Coherence Tomography (OCT), for high-resolution visualization of internal tissues.

CO4. Evaluate and compare laser-based surgical and therapeutic applications, including LASIK, photodynamic therapy (PDT), and low-level laser therapy (LLLT), for precision medical interventions.

CO5. Design and assess fiber optic systems for biomedical sensing and imaging, integrating signal processing techniques and biosensor technologies for non-invasive diagnostics.

CO6. Explore the role of artificial intelligence in enhancing optical medical systems through machine learning, predictive modeling, and emerging innovations in biophotonics.

Course Description:

This lab course introduces students to the principles and biomedical applications of lasers and fiber optics. It includes hands-on experiments with laser-tissue interaction, optical imaging systems like OCT, laser-based therapies, and fiber optic biosensing. Emphasis is placed on medical diagnostics, safety standards, and the integration of AI for advanced optical healthcare solutions.

Course Content

List of Experiments:

1. Introduction to Laser and Fiber Optics in Medicine - Understanding laser fundamentals and properties, Basics of optical fiber transmission and signal propagation, Hands-on demonstration of laser-tissue interaction

2. Laser Tissue Interaction & Safety Measures - Studying thermal effects of laser on biological tissues, Analyzingphotothermal, photochemical, and photoablation processes, Laser safety protocols and regulatory standards

3. Optical Coherence Tomography (OCT) Experiment - Setup and calibration of OCT system, Imaging biological tissues using OCT, Analysis of depth-resolved imaging in medical diagnostics

4. Laser-Based Surgical Techniques - Demonstration of laser-assisted incision and coagulation, Comparative study of laser scalpel vs. conventional surgical tools, Role of lasers in ophthalmology (LASIK simulation)

5. Fiber Optics for Biomedical Imaging - Transmission of light through optical fibers for endoscopic imaging, Optical fiber sensor experiments for biomedical applications, Signal processing techniques for fiber optic imaging.

6. Laser-Induced Fluorescence for Disease Detection - Fluorescence imaging techniques for cancer diagnostics, Spectral analysis of laser-induced fluorescence signals, Real-time detection of biofluorophores in tissues.

7. Photodynamic Therapy (PDT) Experiment - Understanding principles of PDT in cancer treatment, Activation of photosensitizers using specific laser wavelengths, Evaluating cellular responses to PDT exposure

8. Low-Level Laser Therapy (LLLT) for Healing Applications - Exploring tissue regeneration using LLLT, Laser stimulation effects on wound healing and pain management, Parameters affecting therapeutic laser efficiency

9. Fiber Optic Biosensors for Medical Diagnostics - Implementation of optical fiber biosensors for glucose monitoring, Sensitivity and accuracy assessment of fiber optic sensors, Applications of fiber optics in non-invasive diagnostics

10. AI and Advanced Optical Systems in Medical Applications - Machine learning integration in laser-assisted diagnosis, AI-enhanced predictive modeling for laser therapy optimization, Future trends in fiber optic biophotonics.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	**50**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: **Prof. elective- II Lab Laser and fiber optics in medicine Lab** Course Code: BME12041

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	0	0	3	0	0	0	0	0	0	2	3	0	3
CO2	3	2	0	0	3	2	0	2	0	0	0	2	3	2	0
CO3	3	0	0	3	3	0	0	0	0	0	0	2	3	3	3
CO4	3	2	3	2	3	2	0	0	0	0	0	2	3	3	3
CO5	3	2	3	3	3	0	0	0	2	2	0	3	3	3	3
CO6	3	0	3	0	3	0	0	0	0	0	0	3	3	0	3
Average	3	2	3	2.3	3	2	0	2	2	2	0	2.3	3	1.8	3

SEMESTER VII

Industrial Management

MGT11402	HSSM –V (Industrial Management)	L	T	P	C
Version 1.0	**Contact Hours – 40**	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objective

1. To enable students to understand operational complexities of a business.
2. To enable students to conceptualize the process, functions and theories of management.
3. To enable students to provide knowledge about quality control processes.
4. To enable students to conceptualize different strategies relating to people management.

Couse Outcome

On completion of this course, the students will be able to

CO1. Understand operational complexities of a business.

CO2. Explain the concept of process, functions and theories of management.

CO3. Explain the knowledge about quality control processes.

CO4. Explain the concept of different strategies relating to information System management

CO5. Explain the concept of different strategies relating to people management.

CO6.Understand and apply core principles of Human Resource Management

Course Description

The purpose of this course is to provide an understanding of the theories and principles of modern management and encourage the course participants to make an appreciation of these principles in relation to their own experiences and selected managerial case studies. The aims of the course are to understand the basic principles of management, and the four major functions of managers e.g., planning, organizing, leading and controlling and how managers actually operate. Students will be required to think critically and strategically about management theories and issues which will enable them to develop their decision-making and analytical skills. They will be involved in application exercises and case studies, which will assist them to develop graduate attributes.

Course Content

Module 1: Classification and Importance of Operations Management

Operations Management in corporate profitability & competitiveness; Operations strategy; Types & characteristics of manufacturing systems & service systems.

Module 2: Operations Planning and Control

Forecasting for operations; Inventory planning & control; Materials requirement planning; Planning production in aggregate terms; Operations scheduling;

Module 3: Quality Assurance

The quality assurance system; choice of process and reliability; control of quality.

Module 4: Maintenance Function

Preventive maintenance; Overhaul and replacement.

Module 5: Management Information System

Need & structure of MIS; Data Processing Systems; Data Sources & Management.

Module 6: Human Resource Management

Concept and evolution; Manpower planning; recruitment and selection; Motivating personnel; Leadership

Text Books:

1. Yadav, Shashi Kant, Textbook of Industrial Management. Discovery Publishing Pvt. Ltd. ISBN-10: 8183568424 ISBN-13: 978-8183568425.

2. Khanna, O. P., Industrial Engineering and Management, Dhanpat Rai Publications, ISBN-10: 818992835X; ISBN-13: 978-8189928353

Reference Books:

1) Modern Production / Operations Management by Buffa & Sarin, 8th Ed., John Wiley
2) Operations Management by Russell & Taylor (Wiley India Pvt. Ltd.
3) Management Information Systems by Larry Long (Prentice Hall)

4) Enterprise Resource Planning by A. Leon (TMH)
5) Human Resource Management by C. B. Gupta (Sultan Chand).

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: HSSM –V (Industrial Management) Course Code: MGT11402

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	0	3	0	0	0	0	0	3	0	0	0	3	0	0	3
CO2	0	3	0	0	0	0	0	3	0	0	0	3	0	0	3
CO3	0	3	0	0	0	0	0	3	0	0	0	3	0	0	3
CO4	0	3	0	0	0	0	0	3	0	0	0	3	0	0	3
CO5	0	3	0	0	0	0	0	3	0	0	0	3	0	0	3
CO6	0	3	0	0	0	0	0	3	0	0	0	3	0	0	3
Averag e	0	3	0	0	0	0	0	3	0	0	0	3	0	0	3

PC – XIV (Biomedical Instrumentation-II)

BME 11042	PC – XIV (Biomedical Instrumentation-II)	L	T	P	C
Version 1.0	Contact Hours – 60	3	1	0	4
Pre-requisites/Exposure	Basic electronics, electrical, anatomy and physiology				
Co-requisites	--				

Course Objectives:

- To understand the principles and clinical applications of ventilators and anesthesia delivery systems.
- To familiarize students with electrotherapy devices and their therapeutic uses.
- To provide insight into electrosurgical unit design, function, and safety.
- To introduce the basic principles of LASER and its biomedical applications.
- To explain the working of various analytical instruments used in laboratory diagnostics.
- To analyze techniques for blood flow and respiratory monitoring in healthcare.

Couse Outcome

On completion of this course, the students will be able to

CO1: Explain the principles and components of ventilators and anesthesia delivery systems.

CO2: Demonstrate understanding of electrotherapy devices and their therapeutic applications.

CO3: Analyze the working principles and safety features of electrosurgical units.

CO4: understand basics of LASER and its application in biomedical engineering.

CO5: Understand and interpret the working of photometric, spectroscopic, and biochemical analyzers in laboratory diagnostics.

CO6: Evaluate the functionality and applications of blood flow measurement and respiratory monitoring devices.

Course Description:

This course offers foundational and applied knowledge of biomedical instrumentation with a focus on critical life-support systems such as ventilators and anesthesia machines, electrotherapy and electrosurgery units, LASER applications, diagnostic instruments including spectrophotometers and biochemical analyzers, and monitoring tools for blood flow and respiration. Emphasis is placed on understanding operational principles, clinical integration, and safety considerations.

Course Content

Module1:

Basic principles of ventilators, Ventilators and types, Anaesthesia: Need of anaesthesia, gas used and their sources, gas blending and vaporizers, anaesthesia delivery system, breathing circuits

Module 2:

Electrotherapy and different waveforms, Electrode system, Electrical stimulators and types, Strength-duration curve, an electrodiagnostic / therapeutic stimulator. Nerve-muscle stimulators, peripheral nerve stimulator, Ultrasonic stimulators, pain relief through electrical stimulators.

Module 3:

Principles and applications of surgical diathermy, Electrosurgery machine, electrosurgery circuits, solid state electrosurgery generator circuits, electrosurgery safety, testing electrosurgery units, basic principle of ultrasonic lithotripter and extracorporeal shock wave lithotripter. Principle operation of LASER, various application of CO2, argon, He -Ne, Nd – YAG and pulsed ruby LASER, Application of LASER in surgery. Endoscopy

Module 4:

Principles of photometric measurement, Optical filters, Colorimeter, Spectrometer, Design of Monochromators, Flame photometer, Atomic absorption spectrophotometer, Automated biochemical analyzer- Autoanalyzer, Coagulometer, Methods of cell counting Flow cytometry, Coulter Counters, automatic recognition and differential counting of cells.

Module 5:

Oximeter and its Principles, Ear oximeter, Pulse oximeter, Intravascular oximeter. Electromagnetic blood flow meter, Ultrasonic blood flow meter-Transit time and Doppler blood flow meter, Cardiac output measurement-Dye dilution method and Impedance technique, Endoscopy, Pneumotachometer, plethysmograph, apnea detector

BOOKS:

1. **R. S. Khandpur**, *Handbook of Biomedical Instrumentation*, McGraw Hill Education
2. **Leslie Cromwell**, *Biomedical Instrumentation and Measurements*, Pearson Education
3. **Joseph J. Carr and John M. Brown**, *Introduction to Biomedical Equipment Technology*, Pearson
4. **John G. Webster**, *Medical Instrumentation: Application and Design*, Wiley
5. **Bansi Dhar Malhotra**, *Introduction to Biomedical Instrumentation*, Tata McGraw-Hill

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: **PC – XIV (Biomedical Instrumentation-II)** Course Code: BME11042

CO/PO	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	0	0	2	0	0	0	2	0	0	2	3	3	0
CO2	3	2	0	0	3	0	0	0	2	0	0	2	3	2	0
CO3	3	3	2	2	3	2	0	0	0	2	0	2	3	3	2
CO4	3	2	2	2	3	0	0	0	0	0	0	2	3	3	2
CO5	3	2	2	3	2	0	0	0	0	0	0	3	3	3	2
CO6	3	2	3	2	3	0	0	0	0	0	0	3	3	3	3
Average	3	2.16	2.2	2.2	2.6	2	0	0	2	2	0	2.3	3	2.8	2.2

PE- V: Telemedicine

BME11043	Prof. Elective- V (Telemedicine)	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

- To introduce the fundamentals and historical development of medical informatics.
- To develop an understanding of medical data classification, uncertainty, and database management in healthcare.
- To provide knowledge of various communication systems and networks used in telemedicine.
- To explain the security, legal, and ethical issues related to telemedicine and healthcare IT.
- To familiarize students with applications of telecommunication-based biomedical systems across different domains like radiology, cardiology, surgery, etc.

Couse Outcome

On completion of this course, the students will be able to

CO1: Describe the fundamentals of medical informatics, including its history, structure, and applications.

CO2: Analyze classification and management of medical data using database systems in healthcare environments.

CO3:Develop database management systems for healthcare environments.

CO4: Explain various communication types and networks used in telemedicine and biomedical data transmission.

CO5: Evaluate security, ethical, and legal considerations involved in healthcare information systems and telemedicine.

CO6: Illustrate the role and working of telecommunication-based biomedical systems across different medical specialties.

Course Description

This course explores the fundamentals of **telemedicine and medical informatics**, focusing on the structure, development, and applications of computer-based healthcare systems. Students will learn about **medical data management**, **communication networks**, and **security protocols**. It covers various **telemedicine specialties**, including **tele-radiology**, **tele-surgery**, and **tele-cardiology**, along with associated ethical and legal challenges.

Course Content

Module 1: Introduction to Medical Informatics:

Introduction to medical informatics, historical review of development of computers and informatics, structure of medical informatics, Application and importance of Medical informatics**,** Natural language processing, Knowledge and Models**,** Information and Communication Systems**,** Medical Computer Systems **-** Systematization of Computer Applications.

Module 2: Management of Medical data:

Classification of medical data and information**,** uncertainty of medical data, examples of classification systems. Database management, development of database management system for a hospital environment

Module 3: Communication & networks

Types of information: Audio, Video, Still image, Text and Data, Fax.

Types of Communication & network: PSTN, POTS, ATN, ISDN, Internet and Wireless Communications: GSM, Satellite and Micro wave, Different modulation techniques, Types of antenna depending on requirement, Integration and Operational issue: System Integration, Store and Forward operation, Real Time telemedicine

Module 4: Security Issues:

Security Issues in Computer and Internet: Different types of security hazards and methods for prevention of these hazards. Information Safety and Security in Health Care Information Systems, Ethical and legal aspects of telemedicine:Confidentiality and law, Patient rights and consent, access to medical records, consent treatment, intellectual property rights, jurisdictional issue.

Module 5:Tele communication based biomedical systems

Tele-radiology system, Tele-pathology, Tele-cardiology, Tele-oncology, Tele-surgery, Tele-education and Tele-Monitoring.

Books:

1. Telemedicine: Technologies and Applications" – *R.S. Khandpur*
2. "Medical Informatics: Practical Guide for the Healthcare Professional" – *Robert Hoyt & Ann Yoshihashi*
3. "Biomedical Informatics: Computer Applications in Health Care and Biomedicine" – *Edward H. Shortliffe & James J. Cimino*
4. "Handbook of Telemedicine" – *Mohd. Altaf Mir & Rakesh Kumar*
5. "Principles of Health Interoperability: SNOMED CT, HL7, and FHIR" – *Tim Benson*
6. "Computer and Communication Networks" – *Nader F. Mir*

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Elective- V (Telemedicine)	Course Code:	BME11043

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	0	2	2	1	2	0	1	0	2	3	2	3
CO2	3	3	2	1	3	0	0	0	0	0	0	2	3	3	3
CO3	3	3	3	2	3	0	0	0	1	1	1	2	3	3	3
CO4	3	3	2	1	3	0	0	0	1	1	1	2	3	3	3
CO5	2	2	1	0	3	3	2	3	1	2	2	2	3	2	3
CO6	3	2	2	1	3	0	0	0	2	1	1	2	3	3	3
Average	2.8	2.5	1.8	1.25	2.8	2.5	1.5	2.5	1.25	1.2	1.25	2	3	2.6	3

PE V: Tissue Engineering & Design of Implants

BME11044	PE V: Tissue Engineering & Design of Implants	L	T	P	C
Version 1.0	Contact Hours – 40	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objective

1. To describe the principles of tissue engineering clinical applications of tissue engineered products in regenerative medicine
2. To establish the ability to predict single component fluid properties and changes in thermodynamic variables associated with intercellular processes associated with tissues
3. To define the importance of scaffold materials in tissue engineering with focus on surface-, mechanical- and biological properties
4. To describe Biotechnology of stem cells & its applications.

Couse Outcome

On completion of this course, the students will be able to

CO1. Demonstrate knowledge of the difference between cells and tissues and understand how complex structures can arise from simpler components.

CO2: Understand fundamentals of cell culture process including cell types, expansion

CO3. Demonstrate the ability to predict single component fluid properties and changes in thermodynamic variables associated with intercellular processes associated with tissues.

CO4. Demonstrate understanding of common tissue engineering strategies and known solutions for organ replication.

CO5. Apply the combined knowledge of tissue organization and common tissue engineering

strategies to design a unique, plausible tissue engineering solution.

CO6:Apply principles of biomechanics and material science to select, test, and design biomaterials and implants

Course Description

This course will provide an overview of cell biology fundamentals, an extensive review on extracellular matrix and basics of receptors, followed by topics on cell-cell and cell-matrix interactions at both the theoretical and experimental levels. Subsequent lectures will cover the effects of physical (shear, stress, strain), chemical (cytokines, growth factors), and electrical stimuli on cell function, emphasizing topics on gene regulation and signal transduction processes. Tissue engineering will be introduced by reviewing tissue structure and function and the clinical need for tissue repair. An overview of scaffold design and processing for tissue engineering will be reviewed and the application of tissue engineering to specialized tissues and organs will then be addressed in depth. Specific organ systems include skin, muscular skeletal system (vascular grafts, blood substitutions, cardiac patch, and heart valve), nervous system (peripheral and central nervous systems), liver, pancreas, and kidney

Course Content

Module 1:
Introduction, structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing. Cell culture- Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell-cell interaction. Aspect of cell culture: cell expansion, cell transfer, cell storage and cell characterization, Bioreactors.

Module 2:
Molecular biology aspect- Cell signalling molecules, growth factors, hormone and growth factor signalling, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and Cell surface markers.

Module 3:
Introduction to biomaterials and scaffolds, Criteria of modifying biomaterials as tissue engineering scaffolds, Properties and types of scaffolds, Different methods employed in the synthesis of scaffolds, animal cell biology, stem cells, organization of cells into tissues, tissue microenvironment, tissue injury and wound healing 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver.

Module 4:
Basic immunology, response of body to foreign materials. Animal cell culture on scaffolds, consequences, optimization strategies and important considerations for Skin, Liver, Bone, Cartilage, Nerve and Vascular tissue engineering; Case study and regulatory issues-cell transplantation for liver, musculoskeletal, cardiovascular, neural, visceral tissue engineering. Ethical, FDA and regulatory issues

Module 5:

Biomechanical properties of tissues and implants, Selection criteria for biomaterials used in implants, Mechanical testing of biomaterials, Design principles for implants: shape, size, and functionality, Manufacturing processes: casting, machining, additive manufacturing (3D printing), Surface modification techniques: coatings, texturing

Text Books:	
1	Bernhard Palsson, Sangeeta Bhatia ,Tissue Engineering, Pearson Prentice Hall, 2003
2	Robert. P.Lanza, Robert Langer & William L. Chick, Principles of tissue engineering, Academicpress,1997
3	Gordana Vunjak-Novakovic, R. Ian Freshney, Culture of Cells for Tissue Engineering, WIS, 2006
Reference Books:	
1	B. Palsson, J.A. Hubbell, R.Plonsey& J.D. Bronzino, Tissue Engineering, CRC- Taylor &Francis
2	Joseph D., Bronzino The Biomedical Engineering –Handbook, CRC; 3rd edition , 2006

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: P.E. V- Tissue Engineering & Design of Implants Course Code: BME11044

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	0	0	3	0	0	3	0	0	0	3	0	0	3
CO2	3	3	0	3	3	0	0	3	0	0	0	3	0	0	3
CO3	3	3	0	0	3	0	0	3	0	0	3	3	0	0	3
CO4	3	3	3	3	3	0	0	3	0	0	3	3	0	0	3
CO5	3	3	3	0	3	0	0	3	0	0	3	3	0	0	3

CO6	3	3	3	3	3	0	0	3	0	0	3	3	0	0	3
Average	3	3	1.5	1.5	3	0	0	3	0	0	2	3	0	0	3

PE V- AI and Machine Learning Applications in Biomedical Engineering

BME 11045	**Prof. Elective – V AI and Machine Learning Applications in Biomedical Engineering**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hours - 45**	3	0	0	3
Pre-requisites/Exposure	Linear algebra, Discrete Mathematics, Probability, Statistics, Data Structure				
Co-requisites	--				

Course Objective

1. To identify problems healthcare providers face that machine learning can solve
2. To analyze how AI affects patient care safety, quality, and research
3. To relate AI to the science, practice, and business of medicine
4. To apply the building blocks of AI to help you innovate and understand emerging technologies

Couse Outcome

On completion of this course, the students will be able to

CO1: Describe the fundamental concepts, history, and applications of AI and ML in healthcare.

CO2: Perform data preprocessing and visualization techniques for biomedical datasets.

CO3: Apply supervised learning algorithms to biomedical problems and evaluate model performance.

CO4: Utilize unsupervised learning and dimensionality reduction techniques for biomedical data analysis.

CO5: Explain neural network architectures and apply deep learning methods to biomedical data.

CO6:DevelopAI-driven solutions for real-world biomedical challenges including medical imaging, genomics, wearable health monitoring, and clinical decision support systems.

Course Description

Through this course students will be able to play a critical role in enhancing clinical decision-making with machine learning to build the treatments of the future. They will learn to build, evaluate, and integrate predictive models that have the power to transform patient outcomes. The course will begin by classifying and segmenting 2D and 3D medical images to augment diagnosis and then move on to modeling patient outcomes with electronic health records to optimize clinical trial testing decisions. Finally, build an algorithm that uses data collected from wearable devices to estimate the wearer's pulse rate in the presence of motion.

Course Content

Module 1: Introduction to AI & ML in Biomedical Engineering, Overview of AI and ML concepts, History and evolution of AI in healthcare, Applications of AI in disease diagnosis and treatment

Module 2: Data Preprocessing and Visualization Exploratory data analysis, Data cleaning and normalization, Visualization techniques for biomedical data,

Module 3: Supervised Learning Techniques Linear and logistic regression, Support Vector Machines (SVM), Decision Trees and Random Forests, Model validation and evaluation metrics

Module 4: Unsupervised Learning and ClusteringK-means and hierarchical clustering, Principal Component Analysis (PCA), Dimensionality reduction techniques

Module 5: Neural Networks and Deep Learning, Artificial Neural Networks (ANN), Convolutional Neural Networks (CNN) for image analysis, Recurrent Neural Networks (RNN) for sequential data, Transfer Learning and Fine-tuning

Module 6: Advanced Topics in AI & ML, Natural Language Processing (NLP) in biomedical texts, Explainable AI (XAI) in medical decision-making, Ethical considerations in AI applications

Module 7: Applications in Biomedical DomainsMedical Imaging: Segmentation and classification using CNNs, Genomics and Bioinformatics: Gene expression analysis and prediction,Wearable Health Devices: Real-time monitoring and anomaly detection, Clinical Decision Support Systems: AI-driven diagnostics

BOOKS:

1. **Artificial Intelligence and Machine Learning for Healthcare"** – *Arjun Panesar*
2. **"Artificial Intelligence in Healthcare"** – *Adam Bohr and Kaveh Memarzadeh*
3. **"Biomedical Informatics: Computer Applications in Health Care and Biomedicine"** – *Edward H. Shortliffe & James J. Cimino*
4. **"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow"** – *Aurélien Géron*
5. **"Pattern Recognition and Machine Learning"** – *Christopher M. Bishop*

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: Prof. Elective – V AI and Machine Learning Applications in Biomedical Engineering

Course Code: BME 11045

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	0	0	0	3	0	0	0	0	3	0	0	0	3
CO2	0	0	0	0	0	3	0	0	0	0	3	0	0	0	3
CO3	0	0	0	0	0	3	0	3	0	0	3	0	0	0	3
CO4	0	0	0	0	0	3	0	3	0	3	3	0	0	0	3
CO5	0	0	0	0	0	3	0	3	0	0	3	0	0	0	3
CO6	0	0	0	0	0	3	0	3	0	0	3	0	0	0	3
Average	0	0	0	0	0	3	0	2	0	0.5	3	0	0	0	3

Biomedical device Design

BME11047	Open Elective – II Biomedical Device Design	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	Instrumentation, Biomaterials				
Co-requisites	--				

Couse Outcome

On completion of this course, the students will be able to

CO1: Understand the critical design considerations and development lifecycle involved in medical device manufacturing, including the challenges faced by the medical device industry.

CO2: Explain the fundamental design issues and development process of medical devices, including lifecycle and prototyping.

CO3: Analyze forming processes and their application to implantable medical devices, considering material properties and tribological factors.

CO4: Understand and apply laser processing techniques used in the fabrication of microscale medical devices and biomaterials.

CO5: Evaluate machining applications and advanced fabrication techniques for biocompatible implants and microdevices.

CO6: Apply knowledge of manufacturing processes, material properties, and surface treatments to the design and fabrication of high-quality, functional medical implants and devices.

Unit-1 - Design Issues in Medical Devices

Introduction - Need for Medical Devices - Technology Contribution to Medical Devices - Subtractive Technologies - Net-Shape Technologies - Additive Technologies - Challenges in the Medical Device Industry -Medical Device Development - Biomedical Product Life Cycle - Medical Device Development Process - Medical Devices' Design Process - Manufacturing a Prototype

Unit-2 - Forming Applications on Implantable Devices

Forming Applications – Forming - Typical Process Parameters - Temperature– Strain - Strain Rate - Tribology and Micro-Tribology - Manufacturing Process Chain - Manufacture of Alloys and Raw Materials –Forming - Machining and Finishing – Coating - Packaging and Sterilization - Implantable Devices - Bone Implants

Unit-3 - Laser Processing Applications on Medical Devices

Laser Processing procedures - Microscale Medical Device Applications - Processing Methods for Medical Device Fabrication - Biomaterials Used in Medical Devices - Microjoining of Similar and Dissimilar Materials- Laser Micromachining for Microfluidics

Unit-4 - Machining Applications and Advanced Techniques on Medical Implants

Machinability of Biocompatible Metal Alloys - Surfaces Engineering of Metal Implants - Wear and Failure of Metal Implants - Micromilling-Based Fabrication of Metallic Microchannels for Medical Devices - Machining-Based Fabrication of Polymeric - Microneedle Devices - Degenerative Disc Disease - Intervertebral Spinal Spacers - Inkjet Technology - Medical Applications of Inkjet Technology

Books:

1. Biomedical Devices: Materials, Design, and Manufacturing Authors: Raymond H. W. Lam, Weiqiang Chen
2. **Design of Biomedical Devices and System Authors:** Paul H. King, Richard C. Fries, Arthur T. Johnson
3. **Biomedical Engineering Design Authors:** Joseph Tranquillo, Jay Goldberg, Robert Allen
4. **Methods in Research and Development of Biomedical Devices Editors:** Kelvin K. L. Wong, Jiyuan Tu, Zhonghua Sun, Don W. Dissanayake
5. **Metallic Biomaterials Processing and Medical Device Manufacturing Authors:** Amit Bandyopadhyay, Susmita Bose

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: Open Elective – II **Biomedical device Design** Course Code: BME 11047

CO/PO	PO1	PO2	PO3	PO 4	PO5	PO 6	PO 7	PO8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO 2	PSO3
CO1	3	2	2	1	1	2	1	1	-	1	-	1	3	2	2
CO2	3	2	2	1	1	1	-	-	-	1	-	1	3	2	2
CO3	3	3	2	2	2	1	-	-	-	1	-	1	3	3	2
CO4	3	2	2	2	3	-	-	-	-	1	-	1	3	2	2

CO5	3	3	3	2	3	1	-	-	-	1	-	1	3	3	3
CO6	3	3	3	2	3	2	2	1	1	2	1	2	3	3	3
Average	3	2.5	2.33	1.6	2.06	3	1.5	1	1	1.16	1	1.16	3	2.5	2.33

Biomedical Nano Technology

BME11049	Open Elective – II Biomedical Nano Technology	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	Biomaterials, chemistry, physics, anatomy and physiology				
Co-requisites	--				

Couse Outcome

On completion of this course, the students will be able to

CO1: Explain various nanomaterials synthesis techniques including top-down and bottom-up approaches and physical and chemical methods.

CO2: Apply characterization methods such as XRD, SEM, TEM, AFM, EDS, and FTIR to analyze nanomaterials.

CO3: Illustrate the structure, types, and biomedical applications of carbon nanotubes and other nanoparticles for imaging and drug delivery.

CO4: Evaluate the use of nanomaterials in biomedical implants, including neural, hip, knee, dental, ocular, and ear implants, and tissue engineering applications.

CO5: Discuss organic and inorganic nanoparticles, their synthesis, multifunctionality, and applications in biomedical sensing and diagnostics.

CO6: Explain nano fiber technology for preparation of scaffold

Unit 1: Nanomaterials Preparation Techniques

Overview of nanomaterial synthesis; bulk synthesis methods; top-down and bottom-up approaches; physical vapor deposition (sputtering, laser ablation, pulsed laser deposition); chemical synthesis (sol-gel, microemulsion, hydrothermal, spray pyrolysis, spin coating).

Unit 2: Characterization Techniques of Nanomaterials

Nano-scale phenomena; particle size determination; characterization methods including X-ray diffraction (XRD), scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDS), transmission electron microscopy (TEM), atomic force microscopy (AFM), and Fourier transform infrared spectroscopy (FTIR).

Unit 3: Nanotubes and Applications

Carbon nanotubes (CNT) types and biomedical uses; in vivo imaging techniques; nanoparticle applications in tumor detection, drug delivery, genetic diagnostics; nano-robotic medical devices; nanomaterials in MRI, CT, and PET imaging.

Unit 4: Biomedical Implants in Nanotechnology

Nanomaterials in prostheses and implants: neural, hip, knee, dental, ocular, and ear implants; recent advancements in nano-coatings; tissue engineering using nanofiber scaffold technology for biomedical applications.

Unit 5: Organic and Inorganic Nanoparticles and Applications

Biodegradable nanomaterials and synthesis; magnetic nanoparticles and multifunctional inorganic nanoparticles; CNT-based nanoparticles; nano-biosensors including breath gas, glucose, and oxygen sensors for biomedical diagnostics.

Books:

1. Nanotechnology for Bioengineers Author: Wujie Zhang
2. Textbook of Nanoscience and Nanotechnology Authors: B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath, James Murday
3. Biomedical Nanostructures Authors: Kenneth E. Gonsalves, Craig R. Halberstadt, Cato T. Laurencin, Lakshmi S. Nair
4. Nanotechnology for Biomedical Applications Editors: Sreerag Gopi, Preetha Balakrishnan, Nabisab Mujawar Mubarak

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: Open Elective II– **Biomedical Nano Technology** Course Code: BME 11049

CO/PO	PO 1	PO 2	PO3	PO 4	PO5	PO6	PO 7	PO8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO 2	PSO3
CO1	3	2	1	1	2	-	-	-	-	1	-	1	3	2	1
CO2	3	3	1	2	3	-	-	-	-	1	-	1	3	3	1
CO3	3	2	2	1	2	1	-	-	-	1	-	1	3	2	2
CO4	3	3	3	2	2	2	2	1	1	2	1	2	3	3	3
CO5	3	2	2	1	2	1	-	-	-	1	-	1	3	2	2
CO6	3	2	2	2	2	1	1	-	-	1	-	2	3	2	2
Averag e	3	2.3	1.8	1.5	2.1 6	1.2 5	1.5	1	1	1.16	1	1.16	3	2.5	2.33

Bioinstrumentation lab –II

BME12050	**PC LAB XIV-Bioinstrumentation lab –II**	L	T	P	C
Version 1.0	**Contact Hours - 45**	0	0	2	1
Pre-requisites/Exposure	Basic knowledge in Probability and Linear Algebra				
Co-requisites	----				

Course Objectives:

- To familiarize students with basic biomedical sensors and transducers for physiological measurements.
- To provide hands-on experience in designing and testing biomedical measurement systems.
- To enhance understanding of signal conditioning circuits used in biomedical instrumentation.
- To introduce optical and photometric methods for biomedical analysis.

- To enable students to operate standard laboratory instruments used in healthcare diagnostics.

Couse Outcome

On completion of this course, the students will be able to

CO1: Design and develop sensor modules for environmental parameters

CO2: Apply transducer principles for biomedical measurements

CO3: Utilize biomedical devices for physiological parameter measurement

CO4: Design and test basic signal conditioning circuits

CO5: Understand and operate photometric instruments for elemental analysis

CO6: Quantitatively analyze solutions using optical methods

Course Description :

This laboratory course introduces students to the practical aspects of biomedical instrumentation. It emphasizes designing, developing, and testing sensor-based modules and signal conditioning circuits for physiological and environmental parameters. Students will gain experience using photometric, optical, and analytical instruments such as colorimeters, spectrophotometers, and blood cell counters to perform biomedical measurements and quantitative analysis.

Course Content

List of experiments

1. Designing of a temperature and humidity sensing module
2. Designing of pressure measurement system by using LVDT
3. Measurement of oxygen saturation and pulse rate using pulse oxymeter
4. Design of instrumentation amplifier in bread board
5. Study of flame photometer
6. Determine concentration of a solution using Colorimeter
7. Estimation of concentration of different solution using Autoanalyzer
8. Determine concentration of a solution using Spectrophotometer

9. Counting of blood cell using Blood cell counter
10. Counting of blood cell using hemocytometer

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	**50**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	Prof. Core- XIV Lab (Biomedical Instrumentation – II Lab)	Course Code: 12050

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	1	0	0	2	2	1	2	3	2	3
CO2	3	3	2	2	3	1	0	1	1	2	0	2	3	3	2
CO3	3	3	2	2	3	2	1	1	2	2	0	2	3	3	2
CO4	3	3	3	2	3	1	0	0	2	2	1	2	3	2	3
CO5	3	2	2	2	3	1	1	1	1	2	0	2	3	2	2
CO6	3	3	2	2	3	1	1	1	1	2	0	2	3	3	2
Average	3	2.6	2.3	2	3	1.16	1	1	1.5	2	1	2	3	2.5	2.3

Tissue Engineering Lab

BME12052	**PE Lab- III Tissue Engineering Lab**	L	T	P	C
Version 1.0	**Contact Hours - 45**	0	0	2	1
Pre-requisites/Exposure	Basic knowledge in Probability and Linear Algebra				
Co-requisites	----				

Course Objectives:

- To enable students to fabricate polymer-based scaffolds and hydrogels for tissue engineering.
- To synthesize and characterize hydroxyapatite as a ceramic biomaterial.
- To impart hands-on skills in biomaterial property evaluation including degradation, swelling, and hemocompatibility.
- To familiarize students with contact angle measurement and microscopy techniques.
- To train students in sterilization procedures and preparation of simulated body fluid.
- To evaluate the antimicrobial and biocompatibility properties of biomaterials.

Couse Outcome

On completion of this course, the students will be able to

CO1: Fabricate polymer-based scaffolds and hydrogel films for tissue engineering applications

CO2: Synthesize hydroxyapatite as a biocompatible ceramic material

CO3: Measure and analyze surface wettability by contact angle measurement

CO4: Evaluate scaffold performance through degradation and swelling studies, hemocompatibilit, antimicrobial property

CO5: Use microscopy techniques to study tissue structure and morphology

CO6: Perform sterilization of biomaterials using autoclave techniques and Prepare simulated body fluid for biomaterial testing

Course Description:

This course offers laboratory-based learning focused on the synthesis, fabrication, and evaluation of biomaterials for tissue engineering applications. Students will gain hands-on experience in scaffold fabrication, hydroxyapatite synthesis, and hydrogel preparation. The course also covers essential characterization techniques such as contact angle measurement, swelling/degradation studies, hemocompatibility, microscopy, and sterilization procedures, making students industry- and research-ready.

Course Content

List of experiments

1. Fabrication of scaffold using polymers
2. Synthesis of hydroxyapatite
3. Synthesis of hydrogel film
4. Measurement of contact angle,
5. Study of degradation and swelling index of scaffold
6. Hemocompatibility study of biomaterials
7. Use of microscope for study of tissue structure
8. Use of autoclave for sterilization
9. Antimicrobial property of biomaterials
10. Preparation of simulated body fluid

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name: **PE Lab- III Tissue Engineering Lab** BME12052

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	1	2	1	2	2	1	2	3	2	3
CO2	3	3	2	2	2	1	1	1	2	2	1	2	3	2	3
CO3	3	2	2	3	2	0	1	0	1	1	1	2	2	2	2
CO4	3	3	3	3	2	2	2	1	2	2	1	2	3	3	3
CO5	3	2	2	2	3	0	1	0	1	2	1	2	3	2	2
CO6	3	2	2	2	2	1	2	1	2	2	1	2	2	3	3
Averag	3	2	2.3	2.3	2.0	1.2	1.5	1	1.6	1.8	1	2	2.6	2.3	2.6

e					6	5									

Telemedicine Lab

BME12051	**PE Lab- III Telemedicine Lab**	L	T	P	C
Version 1.0	**Contact Hours - 45**	0	0	2	1
Pre-requisites/Exposure	Basic knowledge in Probability and Linear Algebra				
Co-requisites	----				

Course Objectives

- To introduce the architecture and functioning of MySQL.
- To provide hands-on experience using MySQL Query Browser.
- To understand database fundamentals, including DDL and table structures.
- To enable students to perform data retrieval using SQL SELECT and expressions.
- To train students in using SQL functions and DML operations.
- To implement SQL JOINs for relational data manipulation.

Couse Outcome

On completion of this course, the students will be able to

CO1: Understand the general architecture and components of MySQL

CO2: Comprehend database properties and the role of Data Definition Language (DDL)

CO3: Understand table creation, structure, and properties in MySQL

CO4: Use built-in SQL functions to process data within queries

CO5: Perform Data Manipulation Language (DML) operations

CO6: Implement SQL JOIN operations to combine data from multiple tables

Course Description (in brief)

This course offers practical exposure to MySQL database systems, focusing on its architecture, query operations, and data management techniques. Students will learn to create and manipulate tables, use SQL queries for data retrieval and updates, and implement complex JOIN operations. The course strengthens foundational skills in SQL for effective database handling and application development.

List of experiments

1. To study about general architecture of MySQL
2. To interact with MySQL using the MySQL Query Browser
3. To study about database properties and study about data definition languages.
4. To study about MySQL TABLE and its properties.
5. To study about SQL SELECT COMMANDS.
6. To study about the methods and tools needed to utilize SQL expressions.
7. To study about Functions in SQL Expressions.
8. To study about SQL DML Commands.
9. To study about SQL Joins.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course Name:	**PE Lab- III Telemedicine Lab**	BME12051

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	0	0	0	1	2	1	2	2	1	2
CO2	3	3	2	2	3	0	0	0	1	2	1	2	2	2	2
CO3	3	3	2	2	3	0	0	0	1	2	1	2	2	2	2
CO4	3	2	2	2	3	0	0	0	1	2	1	2	2	2	2
CO5	3	3	2	2	3	0	0	0	1	2	1	2	2	2	2
CO6	3	3	2	2	3	0	0	0	1	2	1	2	2	2	2
Average	3	2.8	1.8	2	2.8	0	0	0	1	2	1	2	2	1.8	2

AI and Machine Learning Applications in Biomedical Engineering- lab

BME12053	PE Lab- III AI and Machine Learning Applications in Biomedical Engineering- lab	L	T	P	C
Version 1.0	**Contact Hours - 45**	0	0	2	1
Pre-requisites/Exposure	Basic knowledge in Probability and Linear Algebra				
Co-requisites	----				

Course Objectives

- To equip students with data preprocessing techniques for biomedical datasets.
- To enable students to perform exploratory data analysis (EDA) and meaningful data visualization.
- To build and evaluate classification models for disease prediction.
- To apply machine learning algorithms like Random Forest and CNN in medical diagnostics.
- To explore biomedical datasets such as gene expression, microarrays, and medical images.
- To implement neural network models using deep learning libraries for healthcare applications.

Couse Outcome

On completion of this course, the students will be able to

CO1: Preprocess biomedical datasets by handling missing values, outliers, and applying normalization techniques

CO2: Perform exploratory data analysis (EDA) and visualize key statistical insights

CO3: Generate and interpret correlation heatmaps and feature distributions

CO4: Build classification models to predict disease presence or absence

CO5: Use random forest algorithms to classify medical conditions such as tumor types or diabetes

CO6: Analyze microarray or gene expression data to identify biological patterns

Course Description

This lab-based course introduces students to practical applications of Artificial Intelligence (AI) and Machine Learning (ML) in biomedical domains. Students learn to preprocess and analyze biomedical datasets, visualize trends and relationships, and implement supervised learning techniques for disease prediction and classification. The course also covers advanced neural network models, including CNNs and RNNs, with real-world applications in medical image analysis, survival prediction, and bioinformatics.

List of experiments

1. Handling missing values, outliers, and normalization
2. Exploratory Data Analysis (EDA)
3. Correlation heatmaps, feature distributions
4. Predicting presence/absence of disease (e.g., heart disease)
5. Use random forest to classify tumor types or diabetes
6. Application to cancer classification (linearly separable and non-linear cases)
7. Exploratory Data Analysis (EDA)
8. Identify patterns in microarray or gene data
9. Visualize high-dimensional medical data in 2D
10. Classify chest X-rays / retinal images using Convolutional Neural Networks (CNNs)
11. Build a feedforward neural network using Keras for survival prediction
12. Apply Recurrent Neural Networks (RNN) for ECG or EEG time series classification

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Course PE Lab- III AI and Machine BME12053

Name: Learning Applications in Biomedical Engineering-lab

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	1	0	0	2	2	1	2	3	3	2
CO2	3	3	2	2	3	1	0	0	2	2	1	2	3	3	2
CO3	3	2	2	2	3	0	0	0	2	2	0	2	3	3	2
CO4	3	3	3	2	3	1	0	0	2	2	1	2	3	3	3
CO5	3	3	3	2	3	1	0	0	2	2	1	2	3	3	3
CO6	3	3	3	3	3	1	0	0	1	2	0	2	3	3	3
Average	3	2.8	2.5	2.1	3	1	0	0	1.8	2	1	2	3	3	2.5